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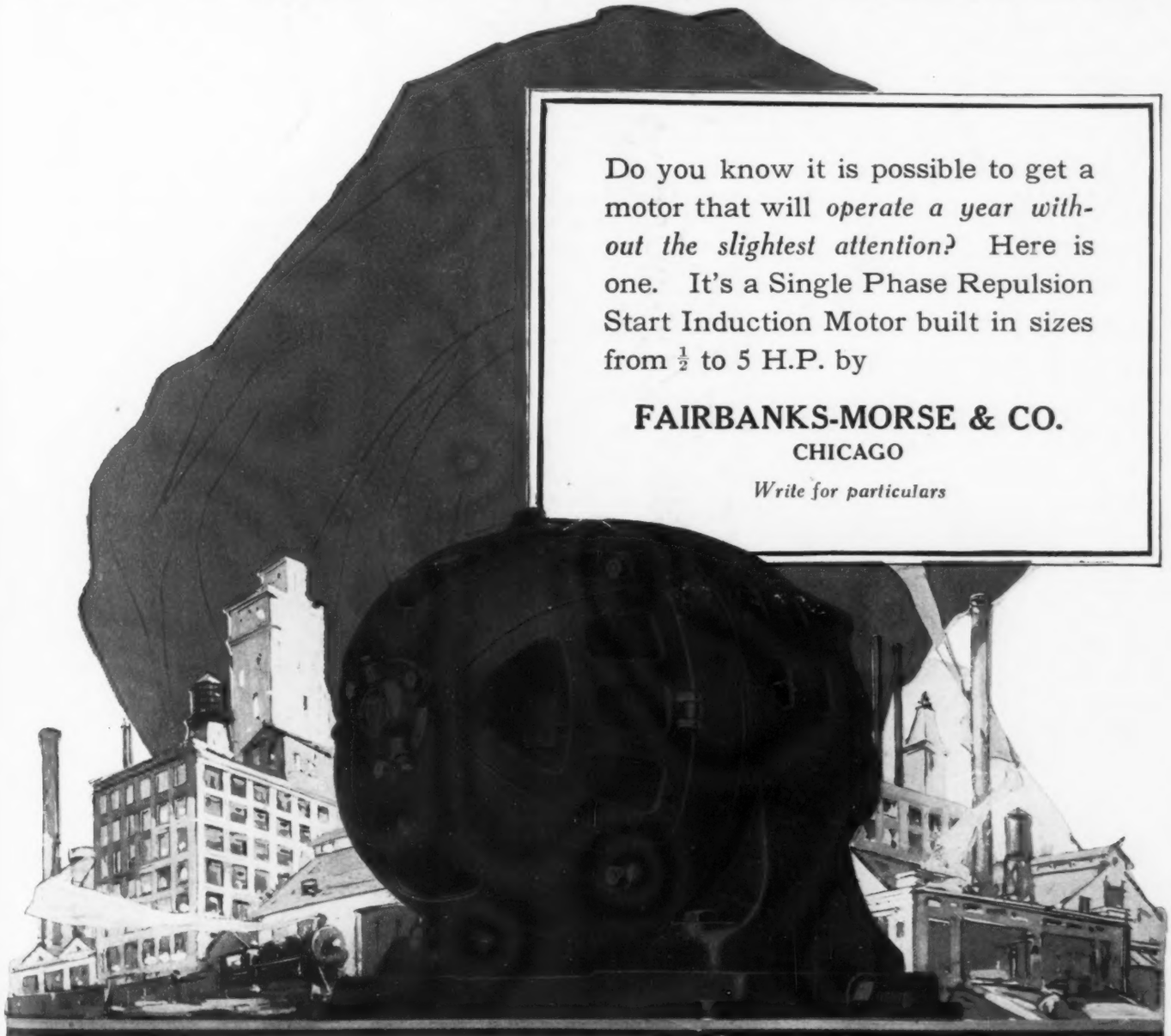

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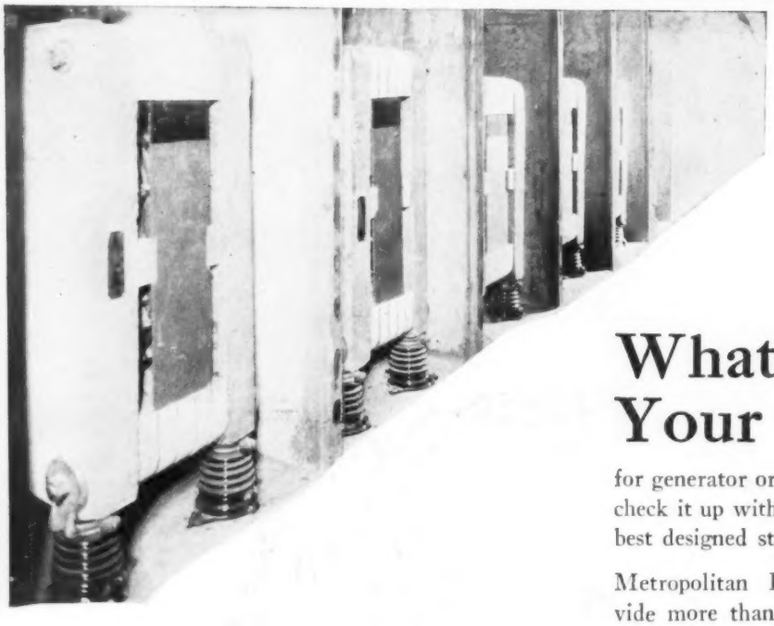

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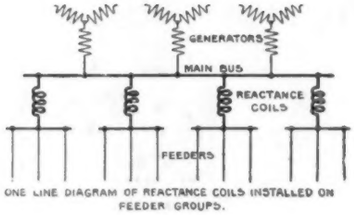

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Electrical World

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Volume 80 — New York, Saturday, December 30, 1922 — *Number* 27

Christmas Business Has a New Meaning

NOT many years ago the Christmas season, from the business viewpoint, stood for little more than anxiety and added responsibility to the central-station executive. It marked the high point of the winter peak—that was about all. For during the very shortest days when the demands of lighting customers were greatest the holiday season superimposed additional demands upon the station.

Stores used larger-sized and additional lamps indoors and installed decorative, outline or festoon lighting outside, and they kept open later. Special sign and street lighting was made a feature of the shopping district. Christmas preparations and merry-making increased the use of light in residences. Factories worked overtime on Christmas business, with extra demands for power and light. And the station ran at capacity and beyond. So the dawn of December 25 was ever welcomed with genuine relief.

The Christmas season was a burden then. But times and conditions have been changing and, while load peaks still exist, the commercial aspect of the season is steadily becoming to the central-station man more what it is to other manufacturers and merchants.

TODAY the Christmas season presents primarily an opportunity to introduce the use of electric labor-saving and comfort appliances into the homes of more people—to extend the idea of the use of electricity. Year after year the sale of electric Christmas gifts increases by tens of thousands of appliances. They have all become standard gifts, displayed and sold in department stores and many other shops that feature Christmas goods, as well as in the stores of every electrical dealer and in central-station salesrooms. We have just witnessed the closing of the most successful selling season for these electrical specialties in our history. And what is the result?

Each season, when the Christmas spirit weakens everybody's sense of thrift, countless men and women who until then have hesitated to spend the money purchase appliances for friends, for relatives and for their own households. Men buy their wives a dishwasher or an ironing machine, or it is decided in the family circle that they would all like best to have the old house wired. Gifts of money are, after Christmas, spent to purchase some appliance that has long been wanted. And the presence of the new equipment in the home inspires the installation of additional convenience outlets that have been needed. All this is business, now established, running into figures almost unbelievable.

IF THIS has come to pass in spite of central-station apathy toward merchandising and in spite of the inexperience of electrical retailers, it is the clear expression of a fast-growing popular desire for electrical appliances and the ability of some merchants to sell these goods. It is irrefutable evidence of a large neglected waiting market not only in the appliances themselves but also in the future energy consumption their distribution means.

William Rowell Putnam

A central-station executive with vision who ranks as an authority on central-station merchandising policies.

THE growth of the electrical industry is primarily a question of the building up of power loads, and to those who have laid the foundation for the growing use of power should be credited much of the phenomenal development of this industry. W. R. Putnam, vice-president and general manager of the Idaho Power Company, is one of this group of builders and pioneers. For the working out of the principles back of the merchandising of electric ranges the industry is indebted to a greater extent to Mr. Putnam than to any other man. As chairman of the electric range committee of the Northwest Electric Light and Power Association in 1917 he made the first comprehensive analysis giving accurate data on costs, merchandising methods and problems of accounting. This led to his appointment the following year as chairman of a similar committee of the National Electric Light Association. The report of this committee still stands as a work of reference in its field.

Mr. Putnam did not begin his career as a utility man. His native state was Minnesota, where after attending the public schools and state university he became a bookkeeper in a Minneapolis bank. Fate, however, saw to it that a small electric property at Red Wing, Minn., should fall into his hands. He spent ten years as manager of this company, turning his hand as occasion arose to every department of the enterprise. He spent the next decade in managerial and executive work with various electrical companies in the Mountain States and the Middle West. The Menominee & Marinette Light & Traction Company claimed his services as general superintendent, and later as general manager of the Dakota Power Company at Rapid City, S. D., he entered the field of hydro-electric power. In 1914 he became sales manager and afterward commercial manager of the Utah Power & Light Company. Here he accomplished a remarkable task in working out cost data so that the status of the commercial department, its costs and its importance to the company could be readily judged. Since 1919 he has been vice-president and general manager of the Idaho Power Company, and under his management this company has converted one out of five residential consumers to the use of the electric range.

Mr. Putnam has always believed in the work of the industry as a whole and has been prominent in association work in every part of the country where he has been stationed. He helped to organize the Minnesota Electrical Association, was active in the work of the Wisconsin Electrical Association and for many years past has been one of the leaders in the Northwest Electric Light and Power Association.

Editorial Comment

Electrical World, December 30, 1922

Volume 80 Number 27

A Resolution for Greater Service

TESTIFYING before the Joint New England Railroad Committee, Judge George Anderson of Boston, a former member of the Interstate Commerce Commission, charged that the steam railroad executives of the country were "lacking in virility, ingenuity and elasticity" and that their "gross inefficiency and arrogance had aroused the hostility of the public as well as of their employees." While it is apparent that Judge Anderson has little or no faith in our privately owned and operated railroads, he nevertheless voiced the opinion already held by many in this country.

The attack is of a nature to arrest attention, and we are wondering whether sooner or later some one of like standing may not make a similar charge against the executives of electric public utilities. At the moment we know of none to whom such a charge would apply. Nevertheless, since this is the season of resolutions, might it not be well for executives of electric public utilities to engage in a little introspection and honestly attempt to ascertain whether they or their organizations are unconsciously acquiring a spirit of arrogance?

The slogan of every electric public utility for the new year should be "Greater service," and if greater service is to be obtained, there must be virility, ingenuity, elasticity and efficiency. Lacking these, failure is inevitable, for our business would then be

> Fixed like a plant on its peculiar spot
> To draw nutrition, propagate and rot.

The Engineer Arrives in British Politics

A COMPILATION of the occupations of members of the new British House of Commons contains the welcome if surprising information that among them are twenty engineers. We shall have to wait for a directory of the Sixty-eighth Congress to know just how many the newly elected House of Representatives will contain, but it is quite certain that there will be nothing like a score. Even were it otherwise, their opportunities for shaping legislation according to engineering standards, as green members of a chamber where experience and priority go for everything and untried ability is at a discount, would be small. In Great Britain, on the other hand, with the House divided between four quarreling factions and with Parliament's direct control over public works in all parts of the country, twenty resolute and united men should be able to accomplish something to infuse efficiency, economy and energy into governmental enterprises where these qualities may be lacking and to maintain them where they exist.

We do not know that the score of engineer M.P.'s are resolute and united. nor are we presumptuously suggesting that they should form a parliamentary "bloc." But in a House where 140 trade unionists will fight for and against the paternalism that they love and hate, where eighty lawyers will divide jurisprudential hairs, where thirty writers will turn statistics and bluebooks into copy, where seven brewers and distillers will watch out lest the pussyfooter gain an entrance, and where two "housewives" will shrill vociferously in a wilderness of males, the solitary clergyman thereto elected might pardonably extend a blessing to twenty engineers whose personal interests are ineluctably intertwined with the promotion of those internal improvements and those friendly external relations on which a nation's welfare is based.

"Our Duty as Well as Our Right"

ELIHU ROOT, speaking as chairman of a meeting of the Council of Foreign Relations, said: "We as a nation must come to recognize not only our rights as citizens, but our duties." Secretary of Commerce Hoover, in a concise and clear essay on "American Individualism," makes of the same thought the basis of the national American principle of equality of opportunity. These expressions of public men are concrete evidence that the way to leadership in this world of mixed affairs lies in putting "duty" before "rights," the moral purpose of individualism ahead of the selfishness of the individual.

There are many applications of these elementary principles, but none more immediate than was developed at the dinner of the Council of Foreign Relations. Our partnership in Europe's problems is needed. Albert Thomas, director of the International Labor Office, Geneva, and a Frenchman whose sincerity and high purpose are evident, says that Europe is on the verge of collapse, not because of economic conditions alone, for there are, he says, favorable sides to these, but "because of the apathy of the working classes as a mass, the 'don't-care' spirit, the hopelessness of peoples sickened by war." Everywhere in Europe, he reports, there is among the producing classes a moral let-down which in its fundamental character he compares with the decline of Rome.

Evidences of this aftermath of war are not absent from America. Costs are high not alone because of maladjustment of the forces of supply and demand, but because the spirit of work, the individual ideal of duty to the job, is lacking. This decline in moral stamina demands drastic action. We must as individuals neither expect profits for less service nor wages for less work. We must as a people recognize duty to a prohibitive law as well as our individual rights as citizens. We must as a nation see our "duty" to our sister nations as well as our "rights."

America has a fraction of the troubles of Europe. Our children are not green with undernourishment as they are in Germany. Our people are not asking for bread and getting stones as in Russia. Relatively as

individuals and as a nation we are well off. What are we doing with our opportunity?

Dean Kimball in his presidential address before the American Society of Mechanical Engineers restated the engineer's relation as a citizen and as an engineer to these problems. Engineers may take an intimate part as citizens in the solution of international affairs by setting up the ideal of duty as well as right.

But engineers have a very practical opportunity to lay the foundation of a better understanding between nations by establishing a means for the exchange of facts regarding industrial and economic life which underlie the political and nationalistic debates. A world engineering survey of oil deposits, oil products and oil requirements as regards production and consumption would form a basis for the discussion of how to divide some local oil region without going to war about it. Men would debate the local division on the basis of a universal knowledge of the location and value of all the world sources, enabling conclusions fair and just to all to be reached. The machinery for accomplishment has not been devised. An engineering bureau of the League of Nations would be quite as fundamental as the Labor Bureau. But in whatever form the machinery is evolved the place and the need of the engineer both as a citizen who can place duty ahead of rights and as an engineer-analyst of facts are obvious, and his assumption of this duty is surely coming.

Why There Is Dearth of Central-Station Salesmen

AMONG the pressing problems confronting central-station commercial managers right now is that of finding suitable men as salesmen both in power sales and appliance merchandising. We hear much comment to the effect that "our old salesmen left us during the war and we can't get men to take their places, so we must start all over and train an entirely new crew." All of this is true, but while these new men are being found and trained to the business it may not be amiss to look back and consider just why the old salesmen left and also why they are not now returning to the central station. In a word, they were not paid enough. Love of the game and a certain fascination about being connected with the light and power company were strong influences to hold some good men for a time even in the face of better offers, but finally in justice to themselves they were forced to go to more lucrative fields.

There are many central-station executives who, through mistaken ideas of economy, have long pursued a backward policy in the remuneration of their salesmen. These salesmen are the ambassadors of the company to the high court of the customer. They are representatives. Yet many companies have been paying salaries so small that they do not appeal to men who could truly represent them, and on top of that in many cases the company executives have given their salesmen that belittling appellation "solicitors." To make these jobs attractive to men of the caliber wanted for this work it is necessary to hold out something more than the glory of the business. There must be both recognition and reward.

If the central-station companies want salesmen who are really competent and not just peddlers, it will be well for many of them to revise their scales of compensation so that this work will carry with it something more than a bare living and specialized experience. Our great central-station industry has been built up by engineers who have stuck with it—why not make the salesmen just as permanent? The market offers plenty of opportunity to interest men capable of real achievement and to pay them well out of the profits that their efforts bring.

The Eternal Problem of Rate Making

THE making of rates for electric service is, and apparently ever will be, a trial to the soul. The real desire, of course, is to play the game fairly and to base rates on sound equity. If there were a system of rates both scientific and practical, it would have been adopted years ago. But, as we have many times said, the problem does not admit a unique solution. The conditions are too complicated and the independent variables too many. The best approximation is obtained by selecting a practicable number of variables and merging the rest by general average into either constantly or simply grouped variables. We publish this week a paper by Messrs. Greene, Schoonmaker and Gorton which admirably deals with this sort of situation. It shows both the general nature of the solution and how it can be worked out with relatively simple assumptions, and in particular it shows the method of treating the demand charges from various viewpoints. We think that as a matter of fact the items of fixed and energy charges cannot be dealt with in a uniform way the country over, so that a fair amount of latitude must be permitted. And after all the commoner factors are duly scheduled the diversity factor is likely to break in with a new set of complications; but by the use of the orderly plans for cost analysis here shown it is certainly possible to lay out a system of charging which broadly is fair to both parties and which may be of real use in smoothing the way. We note and heartily approve the authors' opinion that rates which tend to limit the consumption of energy by underrating service charges and overstressing energy charges are ultimately bad business.

Attain Simplicity in Motor Control

THE problem of motor control in a sugar refinery is on the whole a very unusual one, because the process is imperatively continuous and every part of it must be co-ordinated accurately on pain of serious trouble. Of course, the same general principle controls in other industrial lines, but nowhere else is the working together of the various parts of the process quite so essential. Therefore it is necessary to take as few chances as possible in the matter of motor control, while at the same time a certain amount of interlocking must be regarded as an absolute necessity.

In a broad, general way a constant effort was made in planning the Baltimore installation of the American Sugar Refining Company, discussed on page 1433 of this issue, to attain the maximum of simplicity because of the relatively low grade of labor employed and the large labor turnover. On the other hand, the requirements for continuity necessitated a certain degree of complication. No plant is ideally simple. The engineer has at every stage of design to strike an average between that simplicity which means nearly complete absence of apparatus not absolutely necessary and that simplicity which accomplishes desired results with as little complexity as possible.

One of the radical steps taken in this case was the

abolition of fuses, all motors being under the control of comparatively simple individual circuit breakers. With the equipment provided there is no question as to the size of a fuse, or of what particular fuse has blown, or where the electrician whose duty it is to replace the blown fuse is. Aside from this, the general principle was followed of having the entire control equipment manually operated so far as conditions permitted. Right here the necessity of interlocking intervened, for a certain group of the machines must work together harmoniously to keep the product going in its regular progression. To this end the circuit breakers in any group of machines in which regular sequence has to be followed are electrically interlocked, so that if a breakdown occurs at any particular point all the machines preceding this point also stop, while those following it in the sequence go on and discharge the material in process, thus clearing the way for a fresh start. Before the interlocking scheme was completely worked out it necessarily departed from ideal simplicity, but to good purpose.

A study of this second paper by Roger B. Stevens gives an excellent idea of the progress of orderly design in the details of this particularly modern and instructive industrial equipment.

The Voltage Limit for the Pin-Type Insulator

THE great step upward in voltage in electric power transmission came with the advent of the suspension insulator. The pin-type insulator seemed at about 60,000 volts working pressure to be reaching its practical limitation. There were several good reasons for a limit to appear. First, the manufacture of insulators big enough to have an adequate flash-over limit becomes exceedingly difficult on account of the weight and thickness of the sections and the danger of mechanical imperfection of sectionalization in the interest of better construction is carried too far. Second, it is difficult to make these big insulators thoroughly homogeneous, well vitrified and free from the imminent danger of flaws developing through temperature changes. Finally, the mechanical strains on the whole affair from the wire tied into the top groove become rather serious when the circuit is a heavy one. One of the great outstanding advantages of the suspension type of insulator is that it can allow a certain not inconsiderable amount of end play which greatly relieves some of the strains on the line. An article in the current issue by Paul Ackerman of the Shawinigan Power Company gives a most instructive account of the successful adaptation of the pin-type construction to several 90,000-volt lines.

It is the rather general belief among engineers that the wet flashover voltage of an insulator must give a factor of safety of two to two and one-half, preferably the latter, over the rated working voltage. This opinion we believe to be absolutely well founded, but the Canadian experiment shows that with skill and no little courage a line can be operated on a materially smaller factor of safety, provided one is willing to accept a little inconvenience in the way of temporary failures. As a matter of fact, the system has been running with a very creditable degree of success for the past four years. The tables of failures given in the paper before us show that serious interruptions were few and that interruptions directly chargeable to the low factor of safety were still fewer. Temporary interruptions were rather numerous, but the precautions taken in the way of relay protection were so effective that the damage from brief short circuits was minimized.

The relays were very ingeniously planned to work in pairs, an overload and differential relay pulling together to clear a short-circuited line in the shortest possible time. This protective feature is worth particular attention, and it seems to us to have been a very important factor in maintaining service in spite of "taking a chance" on the insulators. But it seems, too, that the insulators were unquestionably of very high quality as a whole, even if some trouble was experienced from temperature cracking.

Most of the additional difficulty is likely to have come not from direct failure of the insulator as such, but from the shift from delta to Y connection, establishing thus the same danger of grounding on the towers at 60,000 volts that had previously existed between wire and wire with each independently insulated. Bringing the ground up to the individual insulator is likely to enhance the chances of trouble unless the insulator is very materially stiffened, but it is a procedure so necessary at times in transmission work that one must cheerfully take the chance and strengthen the insulator when he gets the opportunity.

Considering this fact, the experience on these circuits from the Shawinigan Falls plant has been remarkably encouraging and speaks volumes for the quality of the insulators. The factor of safety was cut to a figure which would not have been adopted except from necessity, but the care with which the job was engineered enabled the transmission company to get away with it. It is not an example to be followed in planning a new line or in reconstructing an old one if the load conditions are such as to justify the complete expense of reinsulation, but it ought to encourage those who are hard put to it in the matter of line losses to take cheerfully the modest risk involved in raising the voltage without rebuilding the line. To any thinking of such a step we would earnestly pass out the advice to examine very carefully the relay protection, which seems to have been so important a feature in the case before us and to make sure that their insulators are as good as those which have done such sterling duty on the Canadian system.

Predictions Which Come True

ON MAY 14, 1921, we made the following observation on Governor Miller's appointees to the New York Public Service Commission: "On the whole, the Public Service Commission law as revised is good, but the appointees so far must be accepted on faith. Evidently experience in public utility affairs did not count in their preferment. But a body composed of five Republicans appointed for a term of ten years at a salary of $15,000 a year and removable only by impeachment or legislation seems to us to offer an excellent opportunity for Democrats when they come into power to legislate the commission out of office and appoint five of their political faith." This prediction is about to come to pass. The Democrats will come into power in New York next week, and Governor-elect Smith is talking vociferously on "home-rule" regulation for utilities. What we can expect is a new commission with "home rule" as the excuse for legislating the present incumbents out of office. Such is politics.

Value of Airplane Photographs in Plant Reconnaissance Shown at Boston

THE decision by the Edison Electric Illuminating Company of Boston to build a 300,000-kw. steam generating plant at Weymouth, Mass., followed an exhaustive study of Greater Boston and its surroundings, the advantages and disadvantages of various possible sites being carefully considered by the company's engineers and executive officers. In connection with the study of the finally selected site in relation to the town of Weymouth, the general shore line of Fore River, railroad facilities and relative channel depths seven airplane photographs were taken. These photographs, of which two are reproduced herewith, make it possible to obtain a general understanding of the topography at a glance, including cleared and wooded areas, location of buildings, etc. The shore line is well defined, as the pictures were taken at low tide. The relative depths of the water are clearly discernible, as the shallower portions appear much lighter in color than the main channel, which has been dredged sufficiently to float battleships and other large craft which may be launched at the adjacent shipyard.

The new generating station will be built on a tongue of land jutting out into Weymouth Fore River and directly opposite the Fore River works of the Bethlehem Shipbuilding Corporation, Ltd.

Handling Cost Elements in Fixing Rates

How Accurate Cost Analysis May Be Used in the Establishing of Equitable Charges—Why Energy, Consumer and Demand Elements Should Be Considered Separately—Allocation of Demand Costs

By W. J. GREENE, C. F. SCHOONMAKER and C. B. GORTON

IN THE first article of this series (*Electrical World*, Oct. 21, 1922, page 878) a method was given for allocating the energy, consumer and demand expenses of a general light and power system to the classes of consumers. The second article (*Electrical World*, Oct. 28, 1922, page 928) gave an example illustrating the method. This article gives a method by which class rates based on the cost of service can be developed from the costs allocated to the class.

It is now generally accepted that rates for the sale of utility service should follow the cost of rendering the service. This form of rate charges to each consumer the costs incurred in furnishing the service. In the following discussion reasons are given why each cost element must be considered separately if equitable rates are to be developed.

THE unit energy cost should be the same for every consumer of a general light and power system regardless of the number of kilowatt-hours used. Owing to differences in distribution losses, there may be differences in unit energy costs between different systems in the same city and between similar systems in different cities served from a common transmission system. These differences are recognized and are properly reflected in unit energy costs by the method of allocation proposed. Power-plant unit energy costs vary from hour to hour because of differences in power-plant loads, quality of fuel, cost of fuel, the energy portion of material and labor, and operating methods; but there should be no differentiation made in unit energy costs between systems or between consumers of a system because of these variations. Of all of these variables the only one that can be affected by a consumer is the power-plant load, because the size and time of a consumer's load are the only factors under his control, and a change in power-plant load may result in the same, an increased or a decreased power plant unit energy cost. The public utility industry is based on the principle of the economic community of interests, and any change in unit energy costs should be shared by all in proportion to their consumption. To illustrate we will assume a plant with a 5,000-kva. load and with a new consumer about to be added with a 5,000-kva. load, resulting in a total plant load of 10,000 kva. Larger and more economical equipment would be installed for the combined load, resulting in lower unit energy costs. It is evident from a cost basis that the new consumer should not receive a greater portion of the reduced unit energy cost than the other consumers, because the lower unit energy cost was obtained only by the combination of the two loads. Therefore all energy costs should be averaged and any variation in costs should be shared by all consumers of a system in proportion to their kilowatt-hour consumption. Fluctuating prices of fuel, material and labor and generating plant economy can be reflected in rates by providing for periodic adjustments for any variation from a base energy rate.

CONSUMER COSTS INDEPENDENT OF CONSUMPTION

Consumer expenses (Table II, *Electrical World*, Oct. 28, page 930) are those expenses that vary directly with the number of consumers and are independent of the consumers' energy consumption and demand.

The unit consumer cost of a general light and power system may be co-ordinated in a rate as follows:

(1) *Make It a Function of Demand.*—Consumer expenses can be reduced to a unit cost per unit of demand, but when so expressed all consumers whose demands are less than the average demand per consumer would not be charged with their share of the consumer costs. Those consumers with a demand greater than the average would be charged with more than their costs. This method should not be considered because of its inaccuracy and the fact that its application would still further complicate the already difficult problem of co-ordinating the demand costs in rates.

(2) *Make It a Function of the Total Kilowatt-hours Used.*—Consumer expenses can be reduced to an average unit cost per kilowatt-hour, but when so expressed all those consumers whose consumption is less than the average number of kilowatt-hours per consumer would not be charged with their share of the consumer costs. Those consumers who use more than the average number of kilowatt-hours per consumer would be charged with not only their own consumer cost but also with a portion of the consumer cost of those consumers whose consumption is less than the average. The utility may collect all the consumer costs in this manner, but not without discrimination. The real weakness of the method is that it results in inequitable and discriminatory rates.

(3) *Make It a Function of a Certain Number of Kilowatt-hours Used by Each Consumer.*—If an attempt is made to collect consumer costs on a certain number of kilowatt-hours used each month by each consumer, the same objections exist as in the second method, though to a lesser degree.

(4) *Make It a Function of Minimum Charge.*—(a) Collect a portion of the consumer cost in the minimum charge and the balance as a part of the kilowatt-hour charge for the kilowatt-hours included in the first turning point. The error of this method is that those consumers who use less than the average of the kilowatt-hours included in the first turning point pay less than their consumer costs, those who use more than the average pay more than their portion. (b) Collect all the consumer costs in a minimum charge which includes the cost of the kilowatt-hours in the turning point. The error of the plan is that the consumers who use less than the turning point will pay for electricity not used.

(5) *Make It a Separate and Distinct Charge.*—If the unit consumer costs are made as a separate and

distinct charge, the consumer element can be introduced in rates in a simple and accurate manner. Each consumer would pay only his proper portion of the costs.

It has been shown that energy and consumer costs can be reflected accurately in rates by keeping the two elements separate. Demand costs are more difficult to introduce accurately in rates. A kilowatt-hour demand charge can be obtained by dividing the total demand costs by the total kilowatt-hours sold, and the cost can be introduced into rates by adding the result to the unit energy cost; but such a procedure is far from accurate except for those consumers whose kilowatt-hour consumption per unit of demand is approximately that of the weighted average consumption per unit. The arguments given against relating consumer costs to kilowatt-hours apply, but in a greater degree, to the plan of relating all the demand costs to kilowatt-hours. A portion of the demand cost can, however, be allocated accurately on a kilowatt-hour basis. The method of determining this portion will be described in another paragraph.

ALLOCATION OF THE DEMAND COSTS

The unit demand cost found by dividing the total demand cost of a class by the sum of the demands of all consumers in the class would be accurate only for those consumers who have a load factor equal to the weighted average load factor. To those consumers who have a load factor lower than the average will be given a cost greater than their actual costs, and to those consumers who have a higher load factor will be given costs less than actual costs. Demand costs cannot be introduced accurately in rates by the use of a unit demand charge obtained in such a manner.

The method developed for allocating the capacity costs of a class to the consumers of the class is described below:

1. Divide the average monthly capacity expense of the class by its equivalent peak responsibility.

2. Divide the capacity expense of the class for the period by the sum of its consumers' monthly maximum demands.

3. Determine the average monthly load factor of the class, based on the sum of its consumers' monthly maximum demands.

4. Divide the difference between the results obtained in items 1 and 2 by 100 minus the average monthly load factor of the class (item 3). The quotient is the unit charge per unit of demand for a 1 per cent load factor.

5. The unit charge (item 4) divided by 7.3 (1 per cent of average hours per month) is the unit demand charge per kilowatt-hour.

6. The unit demand charge (item 5) multiplied by the kilowatt-hour consumption of the class is the portion of the capacity costs that can be correctly collected on a kilowatt-hour basis.

7. The difference between the capacity costs of the class and the cost determined in item 6 is the portion of the capacity costs that should be collected on a demand basis.

8. Divide the demand portion of the capacity expense (item 7) by the sum of the consumers' monthly maximum demands; the result is the unit demand charge.

In the problem previously given (*Electrical World*, Oct. 28, page 928) to illustrate how a plant's capacity costs are allocated to the classes of consumers the demand costs for each class were: Residences, $853; commercial light, $145.96; commercial power, $254.02.

The load characteristics of the classes were:

	Kw.-Hr.	Equivalent Peak Responsibility	Sum of Maximum Demands
Residences	10,200	70	850
Commercial light	5,780	15	100
Commercial power	16,170	28	120

Applying the method to the data gives:

	Residences	Commercial Light	Commercial Power
1. Unit peak responsibility factor	$12.19	$9.73	$9.07
2. Unit maximum-demand factor	$1.00	$1.46	$2.12
3. Average monthly load factor, per cent	1.64	7.92	18.43
4. Unit charge for a 1 per cent load factor, cents	11.38	8.98	8.52
5. Demand portion per kw.-hr., cents	1.5584	1.23	1.06
6. Demand portion allocated on a kw.-hr., basis	$158.96	$71.09	$171.40
7. Demand portion allocated on a demand basis	$693.88	$74.87	$82.62
8. Unit kva. demand charge, cents	81.6	74.9	68.9
Unit Costs:			
Electricity cost, cents	5.26	4.93	4.76
Demand cost, cents	81.6	74.9	68.9
Unit consumer cost	$1.03	$1.03	$1.03
Total Costs:			
Electricity cost	$536.52	$284.95	$769.69
Demand cost	693.88	74.87	82.62
Consumer cost	825.12	72.40	30.63
	$2,055.52	$432.22	$883.04

The differences between these values and the ones given in the original problem are caused by the use of approximate unit costs.

Any method that would accurately allocate the demand costs of a class to its consumers would require instruments that would show the relation between each consumer's peak responsibility, maximum demand and load factor. The method developed makes some assumptions and there is an error introduced by these assumptions. The amount of the error is greatly reduced, however, because the portion of the costs that are affected by the error is relatively small, and also because in the residence class where the greatest error may occur the probability of any wide variation in the consumers' load characteristics is remote. In this class 67 per cent of the total costs are allocated without any error being introduced. In the commercial light class 83 per cent of the cost is accurately allocated. In the commercial power class 91 per cent is accurately allocated.

It is believed that the economical saturation of a district in the use of electricity depends to a large extent on the form of rate used in the sale of the service. The best development cannot be attained where some classes of consumers are receiving service at less than cost. This places a burden on the remaining classes that will prevent their using the number of units of service that they otherwise could afford to use economically.

If the unit charges for electric service are determined on a cost basis, the consumer and the utility will have a correct measure of the quantity of electricity that can be profitably and efficiently used.

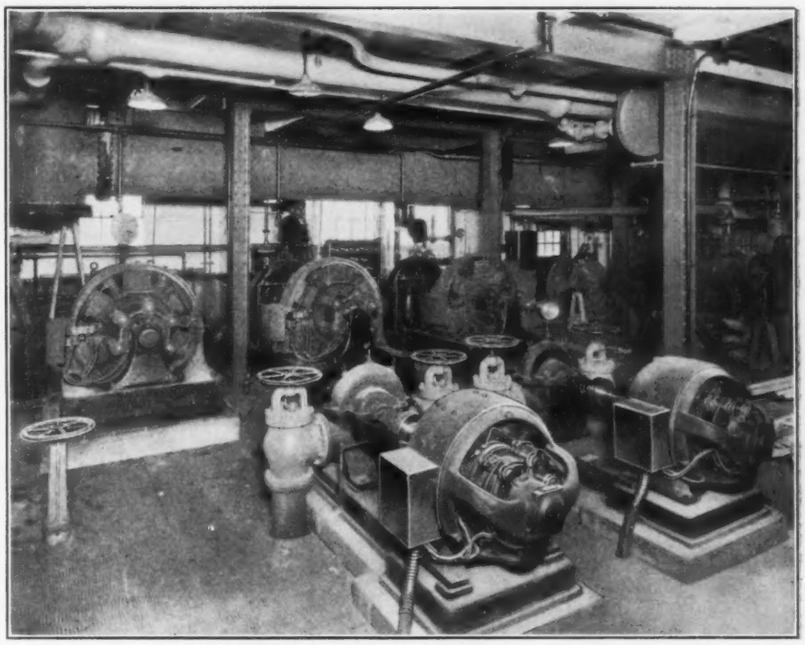
The usual form of rate for residential service is one that tends to limit the kilowatt-hour consumption, because all or a large portion of all the costs are collected on a kilowatt-hour basis. The energy cost of serving residential consumers is a very small percentage of the total costs. If rates were used in which the kilowatt-hour charge covered the energy and a small unit portion of the demand cost, those consumers would have a great incentive to increase the use of energy. No class of service has such a poor load factor as the residential class, and in no class is the possibility of development so great.

Selection and Control of Motors

Avoidance of Service Interruptions Without a Trained and Expensive Maintenance Crew and Under Necessity of Operating with Common Labor Was Chief Problem in American Sugar Refining Company's Plant

By ROGER B. STEVENS*
Consulting Engineer, New York

CONTINUITY of operation, the elimination of the necessity for a large force of trained and expensive maintenance men, the use of common labor (largely foreign and colored) and the high labor turnover attendant upon the employment of this class of workmen were factors as important in determining the selection and installation of motors and control apparatus at the Baltimore plant of the American Sugar Refining Company as in deciding the features of distribution described in the Dec. 9, 1922, issue of the *Electrical World*. In this plant approximately 500 motors, aggregating 7,900 hp., were to be installed, the largest being 300 hp. Motor speeds have been kept low wherever possible, in most cases ranging from 750 to 900 r.p.m. In almost all cases the connection between the motor and the driven equipment is by means of a silent chain, spur or worm-gear reducers or direct application to the driven shaft. As pointed out before, each step in the sugar-refining process is vitally dependent upon those processes immediately preceding and following it, and any change in the production rate at one point must be accompanied by a simultaneous change throughout the chain, or loss will result. Owing to the nature of the labor employed, it would be decidedly out of place to use equipment which requires a high degree of skill and care in its operation. In addition the higher labor turnover makes it essential that equipment be provided which green labor can be trained to operate in a minimum of time.



A FLEXIBLE METHOD OF OPERATING PUMPS IS USED TO CARE FOR FLUCTUATING DEMANDS

In view of the fact that this plant was to be the largest direct-current industrial project that had come up within recent years, and that the attention of manufacturers has been turned for some time almost exclusively to the development of alternating-current industrial equipment, special attention had to be paid to the selection of motor equipment from the standpoint of excellence of construction, dependability of service and the availability of repair-part stocks.

A decision was finally reached that while a number of small manufacturers were in a position to supply direct-current motors which were eminently satisfactory from the standpoint of ruggedness, efficiency and general excellence of construction, the advantages of the service in their own local shops which could be obtained from larger manufacturers were too great to be overlooked. Both the Westinghouse and the General Electric Company could assure the maintenance of a complete stock of repairs and spare parts for all the equipment which they might furnish in Baltimore. As a result, all motors for the power and boiler plants with their starting equipment were purchased from the General Electric Company, and those for the process buildings, with a few exceptions where special equipment was purchased, of which the motors were an integral part, were procured from the Westinghouse Electric & Manufacturing Company.

To take advantage to the fullest extent of the adjustable-speed possibilities of the direct-current shunt or compound-wound motor, every drive where there was the slightest possibility of future change in speed has been provided with a motor whose normal full-load speed is considerably (5 to 25 per cent) lower than the expected requirement. This provision, with the installation of a combined starting and field-regulating rheostat, capable of increasing the motor speed anywhere from 10 to 100 per cent above normal full-load speed, allows almost any possible future requirement within the power of the motor to be met without interchanging motors. To prevent overspeeding of the equipment through careless operation of the field rheostat, the amount of field resistance required for the highest speed under present conditions was determined as soon as the plant started to work, and the excess

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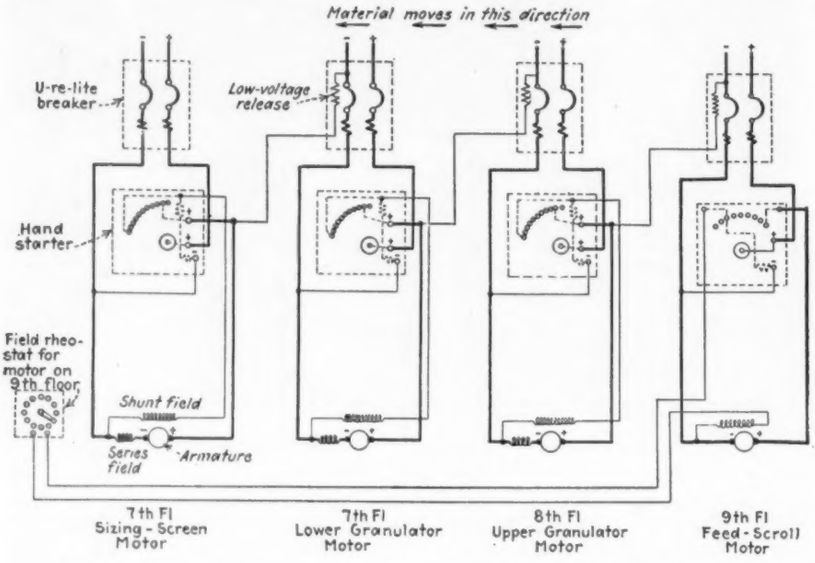
resistance was shunted out with an easily removable soldered jumper.

The factors influencing the selection of equipment which were outlined at the beginning of this article seemed to point to the desirability of providing automatic control. However, the maintenance of an extensive equipment of automatic devices requires the employment of a comparatively large force of high-priced men, and even with the best of care short-time shutdowns for adjustment and minor repairs are bound to be frequent unless a large and expensive stock of spares is maintained and unless routine replacements are made before trouble develops. Consequently, the decision was made that the cheapest and most reliable operation was to be obtained from the installation of as much rugged manually operated equipment as possible and by the use of every available safety device and protective appliance to prevent accident and destruction of equipment from careless and improper operation. Where automatic equipment was required



INTERLOCKING SYSTEM FOR MANUAL STARTERS OF SEQUENCE PROCESSES

every precaution was taken to have it as simple as possible in operation and construction and to protect it in every way from mechanical or electrical injury.

Probably the greatest single step toward the attainment of ideal conditions was made by the installation of individual motor circuit breakers and the complete elimination of the troubles and expense attendant upon the use of fuses.

FUSES AVOIDED

The writer believes that of all the electrical causes of lost time in electrified industrial plants the greatest is the blowing of fuses. Especially is this true in a factory where material is routed through a series of machines or processes in a continuous sequence of operations, each dependent upon the proper and complete functioning of the units immediately preceding and succeeding it in the chain. The blowing of a fuse under these conditions means that an electrician must first be sent for. He must determine the size of fuse required and obtain it from the storeroom and then return and install it—in most cases entailing a total delay of from a half to three-quarters of an hour.

In some factories this delay means a loss which amounts to an astounding figure when proper account is taken of the time lost by the machine directly affected and its operator, the machines immediately following it in the process and their operators, and the machines preceding it, which must be stopped or slowed down to prevent the piling up of partly worked material in an unstable condition. The importance and extent of the indirect losses due to stoppage of machines depends to a large extent upon the nature of the material worked and the amount of storage provided in the various parts of the process.

In the case of a sugar refinery the sugar is almost constantly in a condition which allows it to be left for only a very few minutes without serious deterioration.

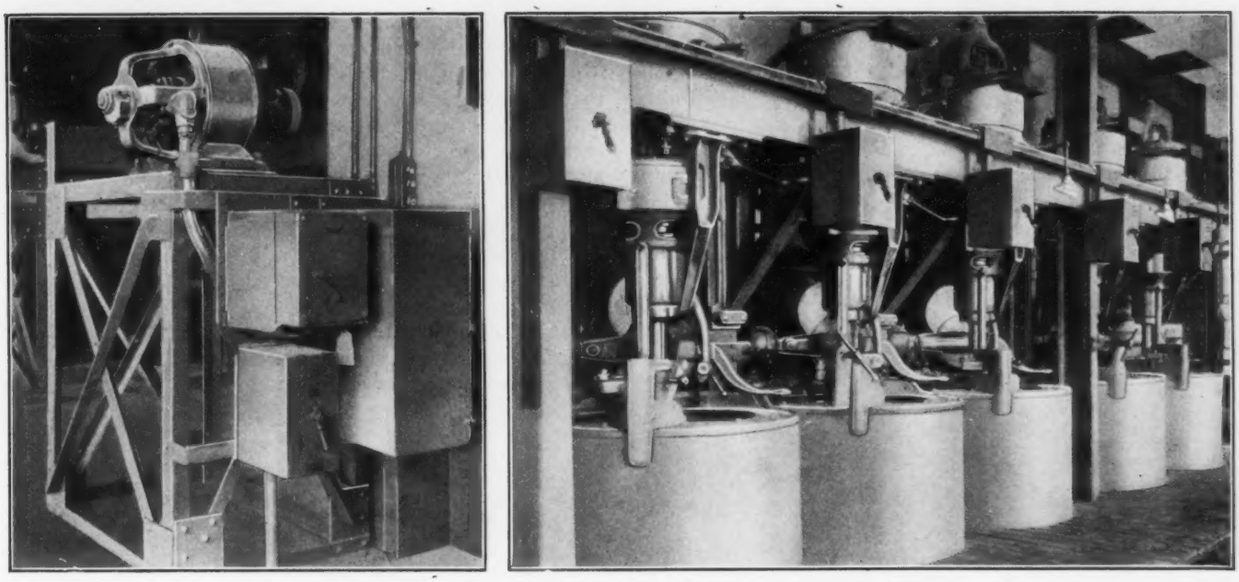
A case very much in point is that of the mixers under the vacuum pans. Each mixer may hold at one time as much as 80,000 lb. of sugar and syrup mixture, and should the agitators stop for any considerable length of time the whole batch hardens and must be dissolved with hot water and put through practically the whole refining process again. During the period while the mixer is being emptied and cleaned—a matter of hours—the four to eight centrifugal machines which depend upon it for their supply of raw material are rendered idle with their operators.

Thus frequent stoppage of equipment and delays in restarting may become very expensive.

The natural result, if fuses are used, is that after a few stoppages due to momentary or continued overload, the electrician in charge puts in a heavier fuse, or the man operating the machine "jumpers" the fuse block with a piece of No. 4 copper wire, where it can't be seen. Then the trouble stops—until a real overload comes along, after which a new motor has to be installed, while the old one is sent to the shop for the rather expensive job of rewinding.

These dangers were realized to such an extent that figures were compiled proving conclusively that the installation of a circuit breaker, provided it could be properly protected from unauthorized tampering and at the same time left available for easy and quick operation, would pay for itself in a surprisingly short time. Such a breaker was made available by the Cutter company at just about the time the designs of the Baltimore refinery were under way. It consists of an "ITE" circuit breaker in a steel box, operated from outside by an insulated handle so arranged that after the breaker is closed it may be blocked or tied in any position without interfering with the overload operation of the arms. This arrangement overcomes one serious objection to the use of breakers on individual motors. In addition, the apparatus is so arranged as to be non-closable on overload, and is equipped with a direct-acting time-limit device to take care of starting overloads. The box may be locked to prevent tampering with the adjustments, and the arms may be locked out to allow repairs with safety.

A feature which made this circuit breaker especially well adapted to the requirements of the present installation is the fact that no overload relays are used, the overload device acting directly on the tripping mech-



SOME PRACTICALLY FOOLPROOF MOTOR AND CONTROL INSTALLATIONS

anism instead of on an auxiliary control circuit, thereby simplifying the mechanism considerably and assuring positive and dependable operation.

THREE CLASSES OF MOTORS TO PROTECT

For the purpose of determining the method of protection to apply, all motors in the plant were divided into three arbitrary classes, depending upon their application, size and method of control, as follows:

1. Motors of 50 hp. and below, with manual starters.
2. Motors of more than 50 hp., with manual starters.
3. Motors of any size with automatic starters.

The reason for differentiating between the first two classes was the excessively high first cost* of the completely inclosed externally operated type of breakers in capacities about 250 amp. For this reason motors of the first class were provided with "ITE" type W. breakers, installed in cabinets identical with those throughout the distribution system, the only difference being that the motor breakers were provided with time-limit devices to take care of starting overloads, while the distributing circuit breakers were so equipped only when the largest motor on the circuit to be protected might be expected to take a starting current comparable with the setting of the feeder breaker.

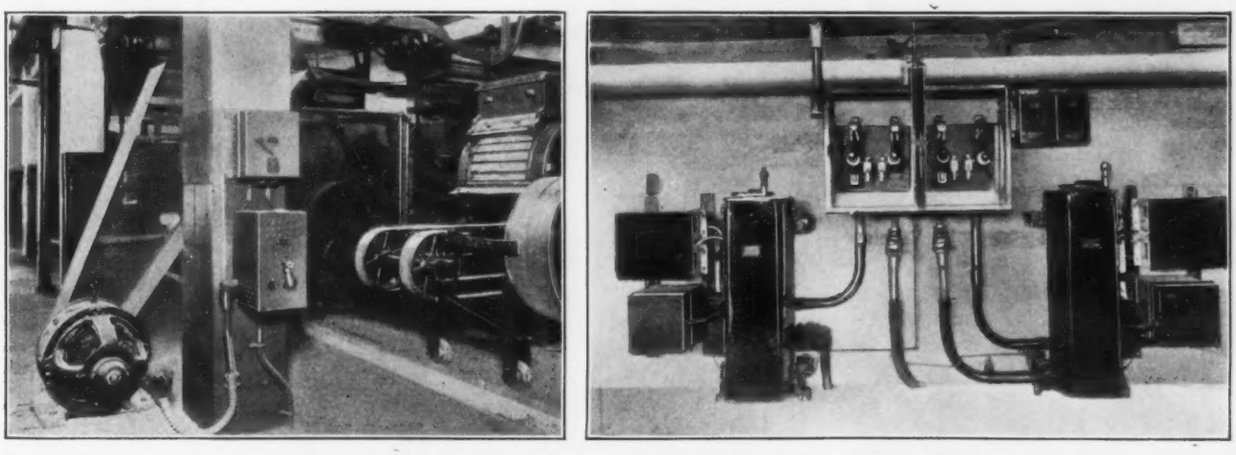
In most cases of this kind the breaker and its cabinet have been grouped with those protecting the other branch feeder circuits from the same floor, and a separate feeder has been run from the breaker group to the individual motor.

Motors of class 2 are in every case equipped with the standard type of fully inclosed breaker. This class includes most of the motors in the plant.

Motors of class 3 required careful consideration. Standard counter-emf. starters (automatic) were available which could be procured with overload trip and time-limit relay protection on the main-line contactors. This allowed them to operate as single coil breakers, but the grounded-neutral lighting system in the plant necessitated the use of two-coil protection. Since this could not be procured as standard equipment from the companies which furnished the other control apparatus, three alternatives were left:

1. Separate circuit breakers could be installed, as in the case of the manually operated machines, but this seemed an unnecessary expenditure when the contactors were already in place and would partly serve the purpose.

*Since the time this plant was designed completely inclosed and externally operated breakers have been developed in the larger sizes at a price proportionate to the smaller ones.

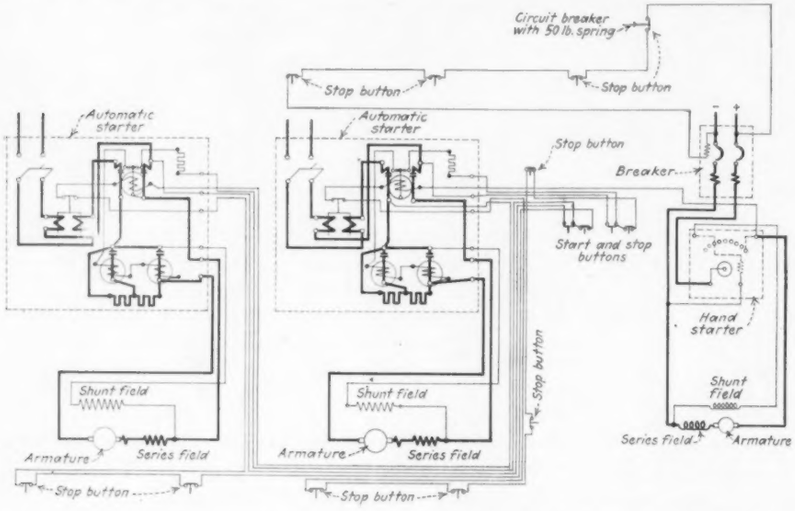


SAFETY SWITCHES AND CONDUIT WIRING CHARACTERIZE THIS INSTALLATION

2. A fuse could be installed in the unprotected side of the line. This was never seriously considered.

3. Starters could be procured from competitive manufacturers with double coil protection. This possibility was considered and dropped, as the automatic starters were to be a comparatively unimportant part of the total installation (from the standpoint of number installed), and it was felt that the advantage to be gained would be overbalanced by the disadvantages introduced by the break in the standardization program and the necessity for carrying a stock of additional parts and familiarizing the maintenance force with another class of control equipment.

The expedient finally adopted was to purchase standard type C counter-emf. controllers with special



INTERLOCKING APPLIED TO AUTOMATIC STARTERS FOR SEQUENCE PROCESSES

double-pole, double-coil overload relays and main-line contactors with time-limit attachment and to dispense with the separate circuit breakers. By purchasing in quantity and under the regular sliding-discount-scale motor agreement, the cost of the controllers so equipped was probably less than the cost of standard equipment from other manufacturers would have been. At the same time, the advantages attendant upon the use of one manufacturer's equipment throughout were retained.

SEQUENCE PROCESSES INTERLOCKED

Owing to the fact that sugar and its derivatives are handled in this factory by a sequence of machines with a minimum of storage facilities between them, it was very important that if one of the machines should stop the machines ahead of it should also stop to prevent piling up of material and flooding of the stopped machine. In the older refineries this result has been partly attained in a rather makeshift way by using the group drive. This has several disadvantages, the outstanding ones being that as the machines are ordinarily placed on different floors in order to obtain a gravity flow of material, the use of belt drives through holes cut in the floor was necessary. Besides, when trouble occurred, the material remaining in the machines could not be run out. Electrical interlocking of the individual machine drives was consequently selected as being more satisfactory.

Interlocking has been effectively carried out by providing the motor breakers with no-voltage-release attachments and supplying voltage for the holding coil on each machine from a point between the motor and breaker of the machine following it in the sequence. In this way the stoppage of a machine from any cause immediately stops all the machines preceding it in the series and prevents piling up of material, while the machines following it continue to run and discharge the material which remains in the system. This has been of special value in the case of elevating and conveying machines dumping into each other and into other machines. This interlocking scheme was also used in the raw-sugar elevators and conveyors. Here complications were added, however, by the fact that three conditions must be met, namely, the continued operation of units 1 and 2, combined operation of units 1 and 3, and independent operation of all three units.

These conditions were met by using a small Westinghouse type M drum switch with the contact fingers changed to give the desired connection changes. To change from night to day operation it is only necessary to move the handle on the master switch from the position marked "independent" to that marked "1 and 2" or "1 and 3" on the accompanying schematic diagram.

The two schemes outlined, or modifications of them, have been used wherever conditions made it desirable, with the result that one of the greatest troubles experienced by the existing refineries has been completely overcome.

One of the most interesting of the motor applications is that in connection with the pumps which furnish cooling water for the jet condensers on the vacuum pans. As nearly as could be calculated when the equipment was purchased, the demand on these pumps might vary anywhere between 3,000 gal. and 13,000 gal. per minute, with the changes taking place almost instantaneously. This meant either that the pumps must be kept running at all times at a sufficient high capacity to supply the greatest possible demand and with a large amount of water going into the overflow during the time of a demand less than maximum or else that a system of control sufficiently sensitive and quick-operating to take care of the rapidly changing demand and maintain a good head of water in the tanks must be designed. The problem was further complicated by the fact that the water supply was to be taken from the Patapsco River at a point where tidal conditions imposed a variable suction head on the pumps, so that the head-delivery characteristic of the pumps could not be utilized to any great extent in maintaining control of the pump discharge.

The problem was solved by installing three centrifugal pumps, each directly driven by a 300-hp. motor with a speed range of 850 r.p.m. to 975 r.p.m. and with a nominal capacity range of 3,000 gal. to 6,500 gal. per minute at a total head of 140 ft. These pumps were arranged to discharge into three tanks all at the same level, the largest of which contains floats operating three eleven-point drum controllers installed at 4 ft., 8 ft. and 12 ft. from the bottom. These controllers in turn operate full automatic starting and ten-point field-control panels at each of the pump motors.

Starting with a full tank and no pumps operating, the operation of the control system is as follows:

When a demand for water occurs, the level in the tanks drops until float No. 1—the upper one—drops sufficiently to engage the first point on its controller. This closes the starting circuit of pump No. 1, and the motor comes up to its slow or full-field speed, delivering approximately 3,000 gal. per minute, more or less, depending upon the condition of the tide and the variations in the pump characteristic, motor temperature, etc. Should the discharge then be sufficient to take care of the demand, the tank level is maintained and the pump continues to operate at its low speed. Should the demand be greater, the float continues to drop and the drum cuts in the trip circuit of the first field-resistor contactor, which drops out and allows the motor to speed up slightly. This continues until either the pump discharge is equal to the demand or the controller has cut in all ten field-control points of the No. 1 pump. Should the latter condition occur, any further drop in the tank level is accompanied by the cutting in successively of the starting and field-control points of the controller for the No. 2 pump and ultimately by the No. 3 unit. The last condition will probably never occur except upon the failure of unit No. 1 or No. 2, as two pumps are designed to supply sufficient water for the present capacity of the refinery.

When the demand on the tanks decreases, the operation of the control is just the reverse of that described.

Unless some means were provided for interchanging the pumps and controls, it may be seen that unit No. 1, which is the first to start and the last to stop in each cycle of operation, would wear out long before unit No. 3 began to show signs of deterioration. In the original design it was proposed to meet this condition by periodically lifting the float and drum controller operating chains from their sprockets and shifting them in such a way that the floats would drop into operating position in a different sequence. However, the inaccessibility of the floats would probably result in their neglect by the operating force. Hence panels carrying six eleven-pole double-throw switches were installed, with the switches so cross-connected that any pump may be connected to any float control. It is expected that the pumps will be rotated as to position in the operating cycle at regular periods.

Education and Industry

By J. B. Whitehead
Dean School of Engineering, Johns Hopkins University

EDUCATION and educational methods are the subjects of continued discussion, largely because of their importance and of the difficulty of arriving at definite conclusions as to the value of particular plans and methods. Their importance is perhaps sufficiently obvious and is attested by the constant stream of suggested modifications pouring in upon educators from practically every field in which the product of our colleges and universities is used. The difficulty in reaching conclusions as to the value of these modifications lies in the length of time involved in giving them a trial and in the uncontrollable variation in the raw material—that is, the student body—upon which the trial is made.

Consequently modifications of existing methods usually come either as the result of some more or less general recognition of desirable qualities in the graduate for a particular field of work, qualities in which he is stated to be conspicuously lacking, or a school may introduce a new plan or a new course, generally to meet a newly recognized need, though often in these cases the motive of self-advertisement is also evident. In the field of engineering we have seen a demand for familiarity on the part of the student with the practical phases of the profession result in a heavy overbalancing of college curricula with a multiplicity of courses on special applications. We are now in the full tide of the reaction from this excess and are approaching a saner recognition of the importance of the fundamental sciences, the English and liberal branches, which make for a broader and more confident outlook, so essential as a foundation upon which the narrower professional training may be laid, to the final product of a resourceful and courageous engineer.

This reaction is one of the most hopeful signs seen for some time by educators, for it indicates a realization of the most serious difficulty with which teachers of engineering have to contend; that is, the poor average quality of the entering student. The first 10 or 15 per cent of the graduating class of any first-class school will usually be found to be well trained and to have many of the qualities now emphasized as desirable, notwithstanding the fact that they may have been graduated from schools which differ quite widely in the matter of curricula and the methods of instruction. The next 40 or 50 per cent represent the great average who have succeeded in getting through but who probably carry away with them little in the way of confident knowledge of the material covered during the period of formal training. The remainder we need not consider, as probably being worse off.

Early Training Leaves Indelible Impression

Now the point is that the topmost group have come through with profit, largely because that somewhere earlier, either through heredity or early training, they have received a sense of personal responsibility, an ability to concentrate on a task, and particularly an unwillingness to advance to new problems until those which have gone before have been satisfactorily solved. The origins of such personal characteristics are very difficult to trace. Probably heredity bears some part, but unquestionably the early processes of training have an enormous amount to do with the subsequent attitude of the student toward his work. In fact, it seems probable that home influence, in the nature of example, personal interest and stimulus, has much more to do with this question than the early character of schooling. And a further point is that the alterations and improvements that are suggested for our regular courses, while they are all helpful and sound in principle, must necessarily be of relatively small importance in their influ-

ence upon the character of the product, owing to the brief period during which the student is in our hands and the wide variation in his natural fitness for undertaking the serious personal effort demanded by the formal course of training for the profession of engineering.

Industry has been slow to recognize these facts, but the reaction referred to above is a direct result of a realization of their importance. The demand for character, stability, independence of thought and action, is a demand for a sense of personal moral responsibility in a young man's attitude, as he takes his place in the bodies social and politic. If this sense is not inculcated in the early influences and training brought to bear upon him, the best way to repair the omission is by education—education, as far as consistent, in the history and experiences of mankind, to be found in the liberal subjects making up the curricula of the college of arts and sciences and forming a foundation upon which the subsequent professional courses may be more safely laid.

Breadth of Training Necessary

But has the reaction toward a broader training, as manifested in changes in the better types of four-year curricula, gone far enough? Educators say they have gone as far as they dare in inserting general and underlying subjects at the expense of professional ones, having in mind the necessity of turning out a graduate who may be reasonably equipped on the technical side. But is the result satisfactory as yet? Certainly a large majority would answer in the negative. Let us consider, then, in further detail the relation of engineering education to industry and see if a method of further improvement is not suggested.

It will be granted without question that the principal object of the school of engineering is the training of engineers, meaning by the term "engineer" one who, to express it briefly, is capable of planning and executing. This being so, it appears that the principal duties of a school of engineering are four, lying in approximately the following order: (1) Training in the fundamental scientific and technical principles underlying the respective fields of engineering; (2) general and cultural studies aiming to fit the graduate for contact with both social and business life; (3) training in the specialization pertaining to the respective fields of engineering; (4) further specialization as related to particular manufacturing and industrial methods.

Criticisms of Present Courses

Criticisms of the product of our present engineering schools are usually made on two general grounds, first, that the equipment for special fields of activity is too limited, and, second, that there is a lack of independence of thought and action, of powers of expression and the like. That is, of the four important duties of a school of engineering mentioned above, it may be said that with the present four-year course of our best type of schools (1) is possible and (2) and (3) may be begun or partially covered. There remains undone much of (2) and (3) and all of (4). If, as in some schools of good standing, more effort and time are given to (2) and (3), it can only be done at the sacrifice of important attention to the other duties.

The situation, then, is obviously unsatisfactory, inasmuch as the product of our engineering schools is really an unfinished one. Apparently it can only be corrected by an elevation of the entire plane of engineering education. The most desirable solution would be to place training for engineering as a profession on a complete graduate basis, requiring a collegiate degree for entrance to the professional school. This, however, is impracticable, if not impossible, because the profession really requires many workers with training considerably short of that pertaining to a finished engineer. Numbers of young men look to positions of this type for an early livelihood and could not, even if they were fitted for it, afford the time for the complete formal training. Furthermore, the industries do not demand, and possibly do not need, very many men of complete professional training. It is these two facts, namely, the rush of young men to the making of a living and the short-sighted demand of the industries for a quick product, which seem to explain our present unfortunate situation.

However, an intermediate plan does appear to be not only desirable but possible. For example, two years of college work in fundamental scientific studies required for admission and three or four years in formal professional courses would go far toward correcting existing difficulties. This plan is now being tried at Columbia University and one or two other places. It is not supported, largely because of the absence of concurrence in the plan by a sufficiently large number of other institutions. Such a plan could obviously include an extension of present specialized courses and the adding of others to meet particular industrial needs.

Many engineering schools recognize the shortcomings of the present situation. They offer to meet it with graduate courses following the regular four years' undergraduate work. This, however, is not sufficient, as is evidenced by the fact that very few students enter these graduate courses.

Concentration on Engineering Principles

It appears, therefore, that engineering education as at present organized can best help the industries not by attempting to add new courses or methods of instruction, but by continued concentration on thorough training in fundamental scientific and engineering principles. In doing this they do not bring their graduate up to a point where he can enter immediately into efficient participation in industrial work, but he is undoubtedly better equipped in this way than in any other for learning by experience to meet special demands. Methods for illustrating the subject matter during instruction by contact with the industries, as, for example, by contemporaneous participation therein by shop work, visits, etc., are all secondary to the main purpose and may well be determined by the opportunities offered in particular communities; but unless it is broadened and lengthened the best standard course in our schools of engineering can do little more than establish a sound underlying and general training.

The industries can best help engineering education, and thereby themselves, first by demanding men who have had some graduate training, and, second, by the material encouragement and support of promising young men through their graduate work by scholarships or otherwise. As long as young men can get reasonably good jobs in the industries at the end of four years, they will continue to take them, and consequently this situation will continue just so long as the industries offer the jobs.

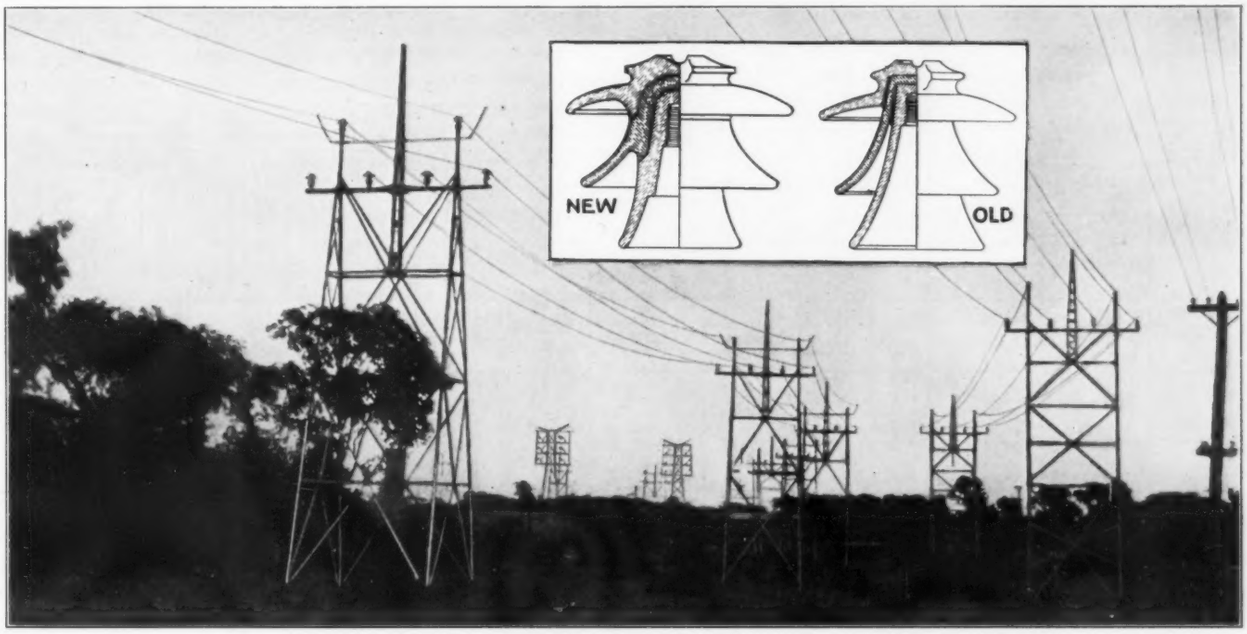
Pin Insulators on 90,000-Volt Line

Changed from 60,000 Volts Delta to 90,000 Volts Y —With Effective Relay Protection and Heavy Duty Oil Switches Found as Reliable as Former Voltage

By PAUL ACKERMAN
Shawinigan Water & Power Company, Montreal

ALTHOUGH it has been the customary practice to consider 60,000 volts to 70,000 volts as the limiting operating pressure for lines supported on pin-type insulators, the tests and experience of the Toronto Power Company, extending over a period of several years, have proved the feasibility of using insulators of this type having only parallel lines separated from each other rather than in close proximity.

The significance of this experience is that it shows the feasibility of raising the line voltage of existing systems without expensive structural changes, except possibly improving the quality of the insulation and installing an effective relay system. This possibility



FIGS. 1 AND 2—NEW PIN-TYPE INSULATORS USED FOR 90,000-VOLT OPERATION, AND OLD TYPE

150,000 volts wet flashover for 90,000-volt Y-connected lines, provided certain conditions are met. In general, these conditions are that effective relay protection and amply large circuit breakers are provided. In addition, the insulators have to fulfill certain requirements, chiefly that they resist puncture and power arcs and that they be built to avoid internal stresses.

Under such conditions 90,000-volt (Y) transmission lines supported on pin-type insulators have proved virtually as effective and reliable as 60,000-volt (Δ) transmission. Furthermore, lightning interference on the 90,000-volt lines has hardly increased compared with that on 60,000-volt lines. Although there are indications which tend to show that the insulation safety factor used on 90,000-volt operation represents about the lowest safe value, there are other indications which show that there still exists ample margin for average conditions. Analysis of the operating results on the Toronto system indicate that more reliable service, even at 100,000 volts, could be obtained, provided the transmission system could consist of three or more may prove of great economic consequence to many companies since it will permit a large increase in their transmission line capacity without great expense. However, each case must be carefully considered on its own merits, since general operating conditions, the layout of the system, the importance of the service, the reliability of the insulators selected, the possibility of effective protection, etc., are all factors which influence the decision on such a change.

Voltages of 60,000 to 70,000 are considered the practical operating limit for transmission lines using pin-type insulators, because it has always been assumed that safe operation necessitates a minimum of wet flashover of at least two to two and a half times the maximum line voltage, and because 150,000 volts to 160,000 volts wet flashover is the practical limit which can be obtained with pin-type insulators of the customary shape. If an attempt be made to build a pin-type insulator of higher wet flashover, it will become unduly large and heavy, or if built in detachable parts it will become mechanically weak by reason of the excessive height.

The adoption of such a high safety factor as mentioned has been chiefly influenced by the enormous number of insulator failures experienced in the past and now fortunately being reduced.

CONDITIONS LEADING UP TO THE STUDY

The lines on which the observations resulting in the foregoing conclusions were made are trunk lines transmitting power from the Niagara Falls power plant to Toronto, a distance of 80 miles. The original installation consisted of one double-circuit steel-tower line with spans of approximately 400 ft. The conductors were arranged in triangular formation 6 ft. apart and consisted of 190,000-circ.mil copper cables. This line was put in operation in the latter part of 1906 at 60,000 volts, it being among the first lines to operate at this voltage.

In 1912 a second double-circuit steel-tower line was erected with 650-ft. spans and 8-ft. conductor spacings, using the same size conductor. At the same time step-up and step-down stations were re-equipped with modern pin-type construction, since any change to suspension insulators would involve too great an expenditure.

(2) The largest economical size of a pin-type insulator having satisfactory mechanical strength and reasonable weight had a wet flashover of 150,000 volts. The ultimate permissible operating voltage on this type of insulator depended entirely on the wet flashover safety factor, which was considered necessary to assure safe operation. Observations on 60,000-volt lines over a period of several years showed that a transmission line with partly damaged insulation operating under trying weather conditions had continued to give service for hours or days until the damaged insulators were found and replaced. An analysis of such cases indicated that for such conditions a wet flashover of about 1.6 to 1.7 times the normal line voltage was sufficient to withstand any line surges except lightning. This flashover safety factor corresponds to 2.8 to 3.0 times the normal voltage to ground so long as the voltage to ground is balanced.

From these observations it was concluded that a pin insulator of 150,000-volt flashover would safely permit 90,000-volt operation, provided flashovers from lightning were accepted.

TABLE I—LINE SHORT CIRCUITS AND THEIR CAUSES

Operating Voltage	Year	Short Circuits Causing Trouble of Transient Nature: Lightning	Bad Insulators	Birds	Slushy Snow	Sleet and Wind	Switching Surges	Blasting	Miscellaneous Outside Interference, Kites, etc.	Unknown	Total Transient Troubles: No.	Total Transient Troubles: Per Cent of Total Shorts	Short Circuits Causing Permanent Damage and Disabling Line Until Repaired: Lightning	Bad Insulators	Sleet and Wind, Tower Collapse, Ground Wire, etc.	Miscellaneous Outside Interference, Kites, etc.	Blasting	Total Permanent Troubles: No.	Total Permanent Troubles: Per Cent of Total Shorts	Grand Total of Shorts
60,000	1916	14	..	..	..	2	..	..	..	1	17	46	6	13	1	..	..	20	54	37
	1917	18	..	..	..	..	..	..	..	..	18	60	1	9	..	2	..	12	40	30
Δ	1918 Jan. 1-Oct.	7	..	1	..	..	..	..	..	..	8	47	5	3	..	1	..	9	53	17
90,000	1918 Nov. 1-Dec.	..	..	1	..	..	..	..	..	..	1	..	..	1	..	..	..	1	..	2
Δ	1919	21	1	..	..	..	..	..	4	5	31	86	2	..	1	2	..	5	14	36
	1920	21	..	2	5	17	..	..	3	6	54	95	1	..	1	1	..	3	5	57
	1921	21	..	2	..	..	2	3	7	22	57	92	1	1	1	1	1	5	8	62
	1922 Jan. 1-Oct. 15	9	..	1	..	..	..	..	2	18	30	75	1	..	8	1	..	10	25	40
Reference Number to Columns	(1)	(2)	f(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)

(3) Lightning flashovers were considered acceptable provided that the insulator was able to resist puncture and power arcs that would permanently disable the line and provided that the line circuit breakers were of sufficient rupturing capacity to clear the short circuits effectively.

From past operating records it could be hoped that about 75 per cent of the lightning short circuits would affect only one line at a time, despite the close proximity of the two circuits on one steel tower. With effective relay protection it could be hoped, furthermore, that all these short circuits would be cleared without interruption to service while operating on two lines in parallel. The remaining 25 per cent of lightning interferences had to be expected to involve both lines simultaneously, but this was not considered a serious matter, provided that the lines were not permanently damaged.

It was realized that 90,000-volt operation would possibly increase the total number of lightning shorts compared with 60,000-volt operation, but the increase was considered to be small.

(4) Operation at 90,000 volts on one double-circuit steel-tower line and on pin insulators of 150,000 volts wet flashover was therefore considered quite safe and

90,000-volt switching equipment of high short-circuit rupturing capacity, to meet the requirements of the increased generator capacity. The lines were to be reinsulated for 86,000-volt operation. At that time the insulator problem proved to be a rather difficult one, and it was finally decided to retain the voltage of 60,000, especially since prospective load conditions did not necessitate the immediate increase of operating voltage—the doubling of lines offering sufficient capacity.

During the war years new conditions arose. One of the four lines was dismantled, the copper being used for other lines. Thus only three lines were left available for the Toronto load. At that time the idea of raising the line voltage was reconsidered, and it was decided that two lines at 85,000 volts would take care of the Toronto load just as well as three lines at 60,000 volts. Thus an increase in line voltage left the prospect of another line becoming available for other use. All lines also badly needed reinsulation. A change to two-line operation on higher voltage saved the expense of reinsulating the third line.

The possibilities of such a change were carefully studied and the observations led to the following conclusions:

(1) Economically, 90,000-volt operation could only be considered feasible if it were possible to retain the

not more hazardous than the then existing 60,000-volt operation on three or four parallel lines, provided that (a) a puncture-proof and power-arc-proof reliable and permanent insulator was developed; (b) an effective relay protection for the double-line system was installed, and (c) flash-overs and occasional momentary interruptions from lightning were accepted.

(5) From investigations of experiences with insulators in preceding years it was concluded that the insulator must fulfill the following requirements to be safe on 90,000-volt operation: (a) its design and the quality of the porcelain must be such as to resist puncture when subject to flashover; (b) it must be glazed all over to eliminate deterioration due to porosity; (c) it must be made of heavy shells and of such shape as to avoid internal stresses so as to eliminate cracking due to sudden temperature changes and so as to offer reasonable assurance of resisting power arcs; (d) severe routine test and most careful inspection must be conducted at the factory.

(6) The relay protection had to be absolutely dependable and equally effective for short circuits from one end to the other extreme end of the line.

Furthermore, it was essential that the protection be instantaneous at either end so as to prevent the serious secondary disturbances on the synchronous load. From past experiences it was evident that the standard principle of protection with time-limit overload relays at the power-house end reverse energy relays at the terminal end of the line was not dependable enough and that a more positive and reliable scheme must be developed.

From the foregoing considerations it was realized that the whole success of 90,000-volt operation on pin-type insulators depended on a satisfactory solution of the insulator and relay problem.

FEATURES OF INSULATOR ADOPTED

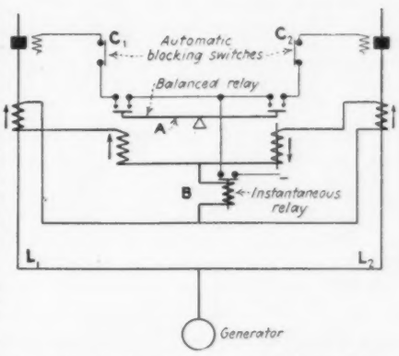
By working in close co-operation with the porcelain manufacturer an insulator was developed of the shape shown in Fig. 2. As may be observed, the insulator is a three-piece unit similar in general appearance to the standard pin-type insulator, but differing considerably in details from the older type.

The new insulator differs chiefly in having thicker shells and more rounded shapes intended to avoid internal stresses. Preference was given to the three-shell insulator, as compared with the four-shell insulator, to obtain heavier individual shells at a fixed permissible total weight. The shells were glazed all over and had smooth sand-glazed surfaces to eliminate surface cracks and moisture penetration. About a thousand insulators were installed on the 60,000-volt lines during the winter season of 1916 to 1917 in order to obtain operating experience.

The relay problem was solved by developing a double-line protection based on the fact that with synchronous load and occasional steam power at the Toronto terminal a short circuit in one of the lines would cause an excess current in the faulty line compared with the sound line. Fig. 3 shows schematically the protection.

This protection was installed early in 1917 on the 60,000-volt lines. In case of a short circuit within one of the two lines there will always be sufficient current difference between the lines to actuate relay *B* and thus trip the faulty line by the joint action of relays *A* and *B*. A detailed description of the protection and four years' operating results were given in a paper published in the April, 1921, issue of the *Journal* of the Engineering Institute of Canada. Tests and operating results proved the system fully effective.

With the relay protection fully up to expectation and the insulators offering promise of success (they had then been in operation too short a time to allow definite judgment), the essential problems for successful 90,000-volt operation were considered solved. As a result the change was decided upon early in 1918. During the summer of that year the lines were reinsulated with the new pin-type insulator. The strain insulators were taken down, retested, and good ones used again in strings of five to seven disks. A limited number of strain insulators of the well-known heavy type were also installed. By October of that year the reinsulation was completed and the change-over to 90,000 volts was carried out. Successful operation has been maintained ever since, and the results are fully up to expectations.



L_1 and L_2 are the two parallel lines. *A* represents a balanced lever which moves to the side of heavier current, thereby selecting the faulty line. *B* is an instantaneous relay connected differentially in the current circuit between the same phase of the two lines, thus responding only to a difference in the line currents. The purpose of this relay is to prevent the balanced lever from tripping any line in case of a short circuit beyond the line. The lever could never be so perfectly balanced that it would remain in the horizontal position with equal current in the two lines. The lever would move to one or the other side and as a result would trip a line if the relay *B* would not keep the trip circuit blocked under any such condition. Switches C_1 and C_2 are automatic blocking switches controlled by the oil circuit breakers in order to avoid wrong relay action under certain conditions.

FIG. 3—RELAY PROTECTION WHICH HELPED MAKE 90,000-VOLT OPERATION WITH PIN-TYPE INSULATORS POSSIBLE

A summary of operating results compared with those obtained with 60,000-volt operation is given in Tables I to IV, and in the following paragraphs:

As may be observed in Table I, which shows the number of line short circuits and their causes for four years with 90,000-volt operation and for the three years preceding with 60,000-volt operation, the total number of short circuits (column 20) increased considerably on 90,000 volts. This would appear unfavorable, but upon closer investigation it will be observed that the low insulation safety factor is hardly to be blamed for this increase. Later it will be shown that the increased number of short circuits in no way influenced the service because of the effectiveness of the relay protection. In most of the short circuits troubles were of a transient nature (columns 11 and 12) and did not disable the line permanently. From columns 18 and 19 it can be observed that the troubles of a permanent nature have been reduced in number. Furthermore, the permanent troubles caused by damaged insulators have been reduced to a negligible quantity (columns 13 and 14), amounting to never more than two permanently disabled lines per year from this cause compared with as many as nineteen in 1916.

Improved insulation is entirely responsible for this

marked change, showing that the quality of insulation is far more important than an excessive safety factor of flashover.

The causes of the large increases in troubles of transient nature can be seen from a study of columns 2 to 10. It will be noticed that the causes indicated in columns 6, 9 and 10 are the chief ones, none of them, however, being the result of low flashover safety-factor.

Sleet and wind (column 6) produce an entirely mechanical trouble due to wires whipping together. Miscellaneous outside interferences (column 9) were also due to mechanical causes—something coming in contact with the line. The increase in this kind of trouble compared with 60,000-volt operation is attributable chiefly to the grounded neutral, since most of these troubles were shorts of one wire to ground. On 60,000-volt delta operation these troubles would have caused a momentary ground without short-circuit disturbance.

Troubles of unknown origin (column 10) may be looked upon suspiciously as being caused possibly by the low flashover safety factor. It may be pointed out, however, that the majority of these troubles occurred during the summer time and during fair weather; that is, at a time when the flashover safety factor was high. Only three troubles occurred during rainy weather; that is, at a time of low flashover safety factor. Another significance of these troubles is the fact that most of them were single wire-to-ground flashovers. This was noticeable on one phase of the oil circuit breaker showing distress, the voltage and load disturbances being light. The foregoing indicates that these troubles were most likely due to birds or kites or outside interferences leaving no trace.

The increased number of short circuits is attributable therefore to the grounded neutral and not to the low safety factor of flashover. The exceptionally large number of unknown troubles in 1921 is probably attributable in part to blasting operations on some large canal construction in the close vicinity of the lines.

The only troubles which could have been caused by the low flashover safety factor are those indicated in columns, 2, 3 and 5. Lightning (columns 2 and 13) would obviously have more tendency to cause flashover the lower the flashover safety factor is. However, operating results indicate that very little change can be observed from this cause. In fact, the lightning season of 1922 indicates a record in small number of lightning interferences compared with the best years of 60,000-volt operation.

The troubles due to slushy snow (column 5) may have been caused by the low safety factor of flashover leaving insufficient leakage path and thus causing a complete flashover. The troubles of this nature all occurred during the same storm under conditions of very heavy wet snow and a very strong wind which packed the wet snow underneath the insulator skirts. It is not impossible that this might have caused these troubles, but this condition seems to occur very rarely. Similar conditions had occasionally arisen previously, when operating on 60,000 volts. In this respect, therefore, 90,000-volt operation may in no way be considered worse than operation at 60,000 volts. There is also serious doubt whether the flashovers occurred on the pin-type insulators or on the strain insulators.

Megger tests on the strain insulators carried out about three months following the foregoing trouble disclosed the fact that there were several strings with only one or two good units, thus presenting a wet flashover of only 50,000 volts to 90,000 volts against the 150,000 volts for the pin insulator. Therefore it would seem more logical to assume that some of the strain insulators may have caused the flashover. Since 1920 the number of disks on strain insulators has been increased and a close inspection is made every year. No similar trouble has been experienced since. Snowstorms of the kind described have been reported since this change without apparent ill effect, but since it is rather difficult to compare the severity of storms of this kind, it is not possible to state definitely the actual cause of the former troubles.

Troubles from switching surges (column 7) have been almost completely absent. The two cases reported in 1921 occurred the same day, when a line was taken out of service, and during fair weather. Nothing was found on the lines to which this trouble could be attributed. Still, in view of the fact that no such troubles were experienced at other times, it is well to assume that at that time some transient trouble existed reducing the flashover value. No direct harm was caused by the switching surges so that their occurrence is not important. With modern sensitive settings on arresters it should be possible to eliminate such troubles entirely.

TABLE II—TROUBLE RECORDS WITH 60,000-VOLT and 90,000-VOLT OPERATION

Operating Condition				Total Interruptions Caused by Following Line Troubles								Line Shorts Cleared by Relay Action or Self-Clearing Without Interruption						Shorts Cleared Without Interruption in	
					Multiple line Sh rt Interruptfng All Lines Caused by														
Operating Voltage	No. of Steel-Tower Lines	Total No. of Circuits	Year	Line Shorts While Operating on One Line	Lightning	Tower Collapse	Bad Insulators	Unknown	Miscellaneous Outside Interference	Total	Total No. Interruptions	Self-Clearing	Are Extinguisher	Parallel Line Protection	Double Line Protection	Total	Total Line Shorts	Per Cent of Total Line Sorts	Per Cent of Total Line Shorts While on Multi-Line Operation
60,000	2	4	1916	6	..	..	..	..	..	..	6	..	9	22	..	31	37	84	100
	2	4	1917	2	4	..	..	..	..	4	6	..	..	8	16	24	30	81	86
Δ	2	3	1918 Jan. 1-Oct.	5	2	..	1	..	1	4	9	..	..	1	7	8	17	47	66
90,000	1	2	1918 Nov. 1-Dec.	..	..	..	..	..	..	..	..	..	..	..	2	2	2	..	..
	1	2	1919	3	5	1	..	..	..	6	9	1	..	..	26	27	36	75	82
Δ	1	2	1920	9	2	..	..	..	..	2	11	..	..	..	46	46	57	81	96
	1	2	1921	2	7	..	..	1	3	11	13	2	..	..	47	49	62	79	82
	1	2	1922 Jan 1.-Oct. 15	5	6	1	..	1	..	8	13	..	..	..	27	27	40	68	78
Reference Number to Columns	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)

Operation during lightning storms has suffered in no way due to the low flashover safety factor, as may be observed from Table III. The total number of line short circuits from lightning is approximately the same with 60,000 volts and with 90,000 volts. On the other hand, there was a marked decline in the permanently disabled lines due to the superiority of the new insulator with respect to puncture and power-arc strength.

From an analysis of Tables I and III it can be clearly observed that the low safety factor of flashover is in no way responsible for the large increase in the total number of line shorts since operating on 90,000 volts. The increase is caused chiefly by the grounded neutral. On the other hand, the tables show that the improved quality of insulation has reduced the permanent insulator troubles to a negligible quantity despite the low safety factor of flashover.

EFFECT OF LINE TROUBLES ON SERVICE RECORD

As shown by Table II, which indicates the service records obtained with 60,000-volt and 90,000-volt operation, the service has not been seriously affected by line troubles, despite the large increase in the number of short circuits, due principally to an effective relay protection and the fact that most of the troubles were of a transient nature. The total number of service interruptions (column 11) was slightly larger than with 60,000-volt operation, but in no way increased in proportion to the number of line shorts (column 17). This increase in the total number of service interruptions, however, is not attributable entirely to the low safety factor of flashover, as will be shown hereafter.

While operating on one single line, line shorts (column 4) are particularly responsible for the large number of total interruptions in 1920. This was attributable to the fact that the 90,000-volt system was only a double-circuit system, so that during a comparatively large part of the time operation had to be maintained over one line, while the other line was out of service for repair, inspection or other purposes. It is rather surprising, therefore, that this cause (column 4) does not have more effect with 90,000-volt operation than with 60,000-volt operation, where four parallel circuits were available.

The total number of interruptions while operating lines in multiple increased in general, as shown in column 10. The causes of such interruptions are tabulated in columns 5 to 9.

Lightning (column 5) seems to have a greater tendency to strike both lines simultaneously. This may be attributed to the reduced safety factor of flashover. In the writer's opinion, however, such increase is incidental, since the induced lightning voltage is of such great magnitude that the small change in safety factor of flashover could hardly have any significance. In any event the simultaneous interference with both lines was primarily caused by the close proximity of the two lines carried on the same steel tower and could be entirely eliminated if the two lines were separated sufficiently to avoid simultaneous interference.

All other interruptions (columns 7 to 9) were caused by interferences where low safety factor of flashover is in no way responsible.

Total interruptions by tower collapse (column 6) due to extremely severe cyclonic windstorms were unavoidable in view of the fact that both lines were carried on the same steel-tower line.

The cause of unknown interference (column 8) was apparently a flashover blowing into the opposite line, thus causing a double-line short circuit, or else was the result of improper relay action due to rather limited generator capacity at that time.

Total interruptions due to miscellaneous outside interferences (column 9) while operating lines in multiple were all caused by a trouble starting on one line and spreading into the adjacent line because of its close proximity.

Line shorts cleared by relay action (columns 13 to 16) indicate how, with effective protection, line short circuits do not have to be dreaded as much as in former days.

As a whole, Tables I to III show why 90,000-volt operation can be considered as satisfactory as, or in fact better than, the previous 60,000-volt operation so far as line insulation is concerned, despite the low safety factor of flashover. All interruptions could have been saved by a trunk-line system consisting of three or more independent single-circuit tower or pole lines sufficiently separated to avoid spreading of trouble from one line to the adjacent one, provided that such a system was equipped with an effective relay protection. It is true that several serious shutdowns have occurred since operating on 90,000 volts, but the cause of these has been mechanical troubles, tower collapse and cable breakages due to exceptionally severe weather conditions. There is only one case that resulted in serious interruption (about one hour) which may be attributable to low safety factor of flashover. This occurred during the snowstorm of 1920, at which time for about an hour no voltage could be maintained on the lines. However, as previously mentioned, there is some reason for doubting whether the pin-type insulators or strain

TABLE III—LIGHTNING SHORT CIRCUITS AND THEIR EFFECT ON INSULATORS

Operating Condition	Year	Shorts Causing Permanent Damage			Shorts Causing Transient Trouble		Total Lightning Shorts
		Puncture	Power Arc	Total	Number	Per Cent of Total	
60,000 Δ	1916	1	5	6	14	70	20
	1917	1	..	1	18	95	19
	1918	4	1	5	7	58	12
90,000 Δ	1919	1	1	2	21	92	23
	1920	..	1	1	21	96	22
	1921	..	1	1	21	96	22
	1922	..	1	1	9	90	10

TABLE IV—SERVICE RECORD OF 90,000-VOLT PIN-TYPE INSULATORS

Year	Approximate No. of Insulators in Service	Number of Damaged Insulators Replaced on Lines							Total No. Insulators Replaced	
		Insulators Disabling Line, Until Replaced Damaged by			Insulators Found on Patrol or Yearly Special Inspection, Damaged by					
		Lightning								
		Puncture of Lowest Skirt, Exploding Upper Skirts	Power-Arc Damage	Bad Insulator	Power Arc from Lightning Flashover	Stone or Shot	Cracked Insulator Uncertain Whether Temperature Crack or from Stone		Number	Per Cent of Total No. of Insulators in Service
1917	1,000	..	..	..	..	..	..		..	....
1918	7,000	..	..	..	..	..	..		..	....
1919	7,000	1	1	..	9	..	..		11	0.13
1920	7,000	..	1	..	7	9	..		17	0.21
1921	7,000	..	1	1	14	14	5		35	0.43
1922	7,000	..	2	..	9	7	15		33	0.41
Reference Number to Columns		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

insulators were responsible for this condition. The foregoing case and the few shorts from switching circuits are doubtless an indication that the practical lower limit of safety factor of flashover is probably approached in these lines. On the other hand, there are other indications which show plainly that, despite the low safety factor of flashover, a considerable margin of safety still exists under normal operating conditions. Some of these observations may be cited hereafter.

In 1919, during lightning and heavy rainstorms, while operating only one line, and with isolated neutral, one of the line cables swung into a telephone pole and burned off. The cable fell to ground and produced a solid ground, thus raising the voltage to ground on the two sound phases to 90,000 volts. Despite the low flashover safety margin on these two sound phases, no flashover occurred. The line operated thus for about ten seconds until the operator cleared the line.

When reinsulating the lines in 1918 the old strain insulators were retested and used again. By some oversight one of the five disk strings was put up with four punctured disks and only one good disk, thus presenting a flashover of approximately only 85,000 volts dry and 50,000 volts wet. Still, the line operated successfully for two weeks on 90,000 volts in dry weather and failed only during the first rainy day, under which condition of course the flashover value of the bad string dropped below the normal voltage to ground.

Lightning flashovers often leave pin insulators with one of the three skirts broken. Yet yearly inspection always discloses a limited number of insulators with cracked skirts which are not causing any trouble despite the reduced flashover value. The inspection is carried out every spring, so that it can be reasonably assumed that some of these cracked insulators existed during the most trying time of wet snowstorms or other bad weather conditions.

FUTURE OF THE PIN INSULATOR

Insulator failures have been so numerous in the past decade that the advocacy of a low safety factor of flashover could only be justified if proof were given of a remarkable change in the quality of the line insulator. Based on a few years' experience only, it is rather difficult to make a definite statement on this point. Still, tendencies of insulator troubles show up usually within the first few years, so that the records of Table IV should offer a fair basis for judgment as to the future of the pin-type insulator used on these lines. According to columns 2 to 4, it will be observed that during the five years' service with this type of insulator only a very few cases occurred in which insulators caused permanent disabling of a line. Only one bad insulator was responsible for the disabling of a line (column 4).

In a few instances lightning caused some power-arc damage, but in only one case did it puncture the insulator, and then only the lower skirt. During two years' service there were only two punctures. In both cases the lower skirt was punctured and the upper shells broken off from the heat effect. It is easily possible that these two insulators may have been overlooked in the factory inspection. Therefore, it can be well hoped that the dreaded trouble of complete puncture as experienced on old insulators is virtually eliminated in this new-type insulator.

Power-arc damage (columns 3 and 5) cannot be avoided unless some arcing ring or horn protector is employed. The damaging effect from this cause, however, is so small, considering the large number of flashovers, that no such complication was necessary.

Damage to insulators found on patrol and special inspection which had not caused line disturbances is enumerated in columns 5 to 7. An insulator was damaged by power arc during a lightning storm without, however, permanently disabling the line (column 5). The number of insulators damaged by malicious outside interference is shown in column 6. This is an unavoidable loss, but owing to the ruggedness of the new insulator this loss has also been reduced as compared with the old 60,000-volt insulator.

The only damage which raises some doubt as to the permanency of the new insulator is the one indicated in column 7. The old 60,000-volt insulator had developed temperature cracks in the head in an alarming way. Similar cracks showed up on the bottom disk of the new 90,000-volt insulator from the bottom rim upward. No sign could be detected of chipping, which would have indicated that the cracks were caused by stones or shots. Hence it was admitted that they might have been caused by excessive temperature changes. Upon close investigation it was found that 75 per cent of all the damaged insulators were in zones where injury to insulators from stone throwing had always been excessive. The remainder were all near country roads or other easily accessible places where outside interference would be quite possible. Not a single case was found at an isolated cross-country point. While, therefore, there is some doubt left as to the actual cause of these cracks, there is very strong reason to believe that the insulators were damaged by stones or shots.

The records of Table IV are very encouraging and indicate plainly that the modern pin-type insulator is not afflicted with the serious ailments of the older type, but is becoming as reliable as any other part of the transmission line, provided that the proper type and quality of insulation is chosen. Operating experience on the 90,000-volt lines shows that it was perfectly justifiable to adopt a very low safety factor of flashover based on the assumption of being able to obtain a pin insulator of high quality and permanency.

Appreciation must be expressed to F. G. Clark, chief engineer of the Toronto Power Company, whose courageous and optimistic stand and confidence in the engineer's recommendation permitted the realization of this feat, which would have been considered reckless by the majority of engineers, but which has proved to be fully feasible and may have a considerable economic influence on future transmission engineering.

Amsteg Station of the Swiss Federal Railways

ON Nov. 22 the large Amsteg power station of the Swiss Federal Railways was put in operation. This station, in the Canton of Uri, furnishes the electric energy for the Gotthard railway lines, receiving its power from the River Reuss, the Tellibach, the Kärstelenbach and the Etzlibach. It is the largest of the hydroelectric plants of the Federal Railways. Its completion required 800,000 man-days, 180 tons of explosives and 150,000 tons of cement. The station, together with those of Ritom and Göschen—the latter at the entrance of the Gotthard tunnel—will supply the entire electric power for the traffic on the Gotthard line from Basle to Chiasso and in addition supply the energy for the branch lines from Lucerne to Zurich and from Thalwil to Richterswil

Solving the Merchandising Problem

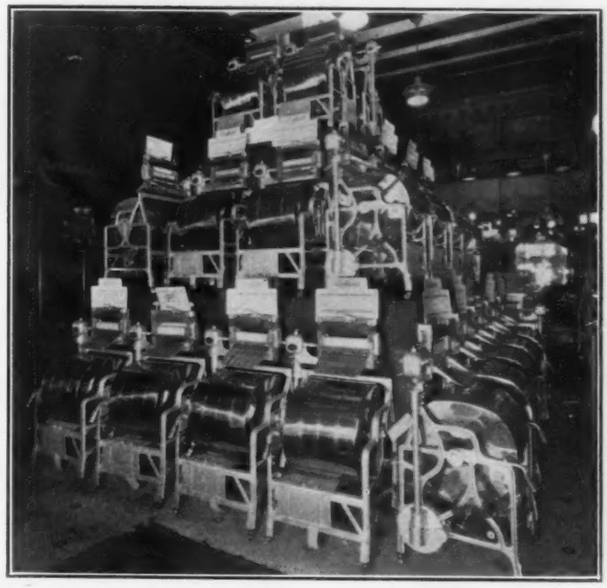
How the Pittsburgh Utility Formed a Separate Company to Operate a Chain of Gas and Electric Shops Exclusively for Sale of Appliances at a Profit

ONE of the broadest and most comprehensive merchandising policies yet adopted by an electric light and power company is presented in the organization by the Philadelphia Company in Pittsburgh of a group of chain stores in the territory served by that company's subsidiary gas and electric properties. For a number of years the company has been endeavoring to develop a means of offering to its customers adequate facilities for the purchase of household appliances. All of the space in the company's general office building in the Pittsburgh business section, however, was taken up by executive and clerical offices. Moreover, the location of this building was not suited to the merchandising of appliances to the best advantage. Nevertheless, the company believed that it had a further duty to perform than merely delivering gas and electricity regularly in a given quantity. It considered that it was just as much a part of the company's service to offer customers a store where they could inspect and purchase the right appliances.

After making a careful study of the problem it was decided to establish a number of branch stores within convenient reach of all customers. With this purpose in mind the Equitable Sales Company was formed in November, 1920, and stores were opened at a number of important points in Pittsburgh and vicinity. In July, 1921, Harvey A. Keys, formerly an active figure in Chicago's electrical circles as division manager of the Commonwealth Edison Company's electric shop for ten years, was made vice-president and general manager of the company. One of his first moves was to christen the stores the "Gas and Electric Shops," and by that name they are rapidly becoming a household word in Pittsburgh.

These shops, of course, were primarily to provide adequate means for the display and sale of appliances, but to encourage customers to visit them facilities were provided in each of the stores for customers to meet the officers and employees of the company for the adjustment of service or misunderstanding, for making application for service as well as the payment of bills and for obtaining information relative to the use of the appliances and fixtures which would give the most satisfactory and economical service. Six stores in all, each called the "Gas and Electric Shops," have been in operation since November, 1920, and it is the most extensive operation yet undertaken in Pittsburgh for the sole purpose of merchandising appliances.

The accompanying illustrations and the group of views on page 1446 of this issue show the interior and exterior arrangement of the stores, which are all designed to give the best possible display to the appliances. The largest is established in the Jenkins Arcade in the Pittsburgh shopping center and is so situated that two whole sides of a large storeroom are given over to window space which is used for display purposes and the constant demonstration of some appliance. These windows are so arranged that in addition to the articles



AN INTERIOR DISPLAY OF ELECTRIC WASHERS WHICH BROUGHT GOOD RETURNS

shown in the windows passersby have an unobstructed view of the appliances on the floor. Inside, all-glass showcases are provided for the display of heating appliances and wall cabinets are used for the smaller appliances and lamps.

A notable feature of the main store as well as the other shops of the Equitable Sales Company is the number of appliances shown on the display floors. Of each of the larger devices such as washing machines, vacuum cleaners and ironing machines at least four or five are shown. But this is done without giving the shop a cluttered-up appearance, and it has the distinct advantage of impressing visitors with the stocks carried and the popularity of the appliances.

In addition to the large Jenkins Arcade shop, one is located in the East Liberty section of Pittsburgh on Penn Avenue and another on the north side on West Ohio Street. Others are in McKeesport, Sewickley and Beaver Falls, The general layout of all of the shops is very similar. A cashier's window is found at the rear of the store so that customers coming in to pay bills or place an order for service must of necessity pass the showcases and the appliances displayed on the floor. This has proved valuable in arousing interest and making openings which salesmen can follow up.

As the Equitable Sales Company is an entirely separate and distinct company from the gas and electric utilities in Pittsburgh, the stores are conducted to make a profit, and they have so far been better than self-supporting. In discussing the merchandising operations of his company Mr. Keys explained some of the methods and policies which are followed and emphasized the prime importance of quick stock turnover, the need of

Salesrooms and Windows of the "Gas and Electric Shops," Which Perform a Real Merchandising Service in Pittsburgh

constant use of active demonstrations of appliances in the windows and storerooms and the value of a liberal use of advertising.

"Window demonstrations, particularly for the stores in busy sections," said Mr. Keys, "are to my mind the most valuable means we have of attracting people to our stores. They result in increasing the sale not only of the appliances being demonstrated but of others as well. Not that we always are, but we try to keep, just a month or two ahead in the preparation of features for displays and demonstrations as we attempt to have something in the way of a change every two weeks.

Featuring Window Demonstrations

"Last summer we played up electric curling irons with demonstrations in our windows. Three girls from sixteen to eighteen years old with bobbed hair acted as models. They had previously shampooed their hair so it would be perfectly straight, and then the use of the electric curling iron was demonstrated. The window was furnished with a dressing table and chairs, and each model served about an hour and a half each day. So many spectators were attracted to our windows that traffic officers had to keep a space on the sidewalks cleared. As a result of these demonstrations curling-iron sales were tripled and have held up very well since that time.

"Special displays of washing machines are made during campaign drives, the most recent being a massed display in the form of a pyramid as shown in one of the accompanying cuts. Each machine was marked with a display card, and the bottom row of machines was kept in operation. Spotlights were directed at the display, and the attention it attracted well repaid us for our trouble.

"Another demonstration which attracted large crowds was that of a man attired in a tuxedo suit with a mask over his eyes to lend an air of mystery. This man turned a series of cards which described the features of an electric washer, and at the same time he pointed out these features on a machine in operation. After two weeks his costume was changed to represent that of a red devil, and this revived interest for another two weeks. Other demonstrations which have never failed to draw people to our windows and into the stores have been electric flatirons, ironing machines and cleaners.

"Advertising, both direct by mail and in the newspapers, brings very good sales results. We have established a policy of setting aside 5 per cent of the gross amount of our sales for advertising. Lately we have been sending out folders with return post cards in broadsides of five to ten thousand. While we cannot tabulate the number of returns, they have been very satisfactory and have kept our salesmen busy following them up. We will continue this form of advertising.

"On some of the larger appliances—that is, the vacuum cleaner, washer and ironing machine—we are operating on the resale plan whereby the manufacturer supplies a crew of salesmen under a supervisor. These men are paid by the manufacturer but work from our stores, and we receive a percentage on each machine sold. While this does not give us such a large gross volume of sales, it cuts down the selling cost and does away with high investment in stocks. At present there are forty such salesmen working on cleaners and twenty-five on washers and ironers. Other electric appliances are sold from the shops and are a part of our regular merchandising business.

"We find that we must watch our stocks very closely and buy in such quantities as will keep our rate of turnover high. By this is meant that on an article about which we have any doubt of its moving quickly we prefer to buy in less than standard lots and sacrifice some discount rather than take the miximum-quantity discount and find later that we have considerable money tied up in dead stock. All material received and disbursed is entered daily in a stock ledger which gives us a day-to-day inventory of the stock on hand. On fast-moving material a minimum quantity is established and a reorder comes through automatically when this point is reached. Under this arrangement stock is renewed without delay and we are able to keep our stock investment at a very low figure. Not considering the appliances sold on the resale plan, we will turn over our stock investment about ten times during 1922.

"We endeavor to carry as complete a line of electrical equipment and supplies as we can sell. In addition to appliances and lamps we carry regularly such articles as tape, lamp cord, knobs, tubes and cleats, dry batteries, wire and radio supplies. There is a surprisingly good demand for this class of material, and as it is all sold over the counter for cash and the customer takes it with him, involving no delivery expense, we find it extremely profitable. On some articles there is, of course, a marked seasonal demand and care must be taken not to carry these over for six months or a year.

List Prices Maintained

"Unless it becomes necessary to mark down the price of some appliance that is becoming shopworn or has proved to be a slow mover, we do not make any special offer. This policy has been adopted for two reasons: We want to maintain list prices, and there is not sufficient margin to permit of cutting prices and making a profit.

"Of the appliances the best sellers are irons, curling irons, toasters, heating pads, grills, percolators, washers and vacuum cleaners. This year's sales of three leaders will be approximately 3,000 washing machines, 3,600 vacuum cleaners and 7,000 electric irons."

The organization to handle the work is comparatively simple. There is a general office in the Jenkins Arcade, where Mr. Keys makes his headquarters and where an office force has charge of the records of all sales and the issuing of orders for the delivery and installations of appliances sold. Here also is a shops manager who supervises the appliance shops. At each of the "Gas and Electric Shops" is a store manager who has charge of his store and the salespeople who are working in the territory surrounding that store. Salesmen report to these stores and not to the general office. In addition, there is a general storeroom where stocks are maintained and disbursed to the different shops as needed. This is in charge of a storekeeper.

While Mr. Keys prefers not to quote actual figures, he points out that the "Gas and Electric Shops" are organized as an independent merchandising business and that, while it is not large, a profit has been made on the year's operations. In this connection it is worth noting that during the first year the shops had to go through the confusion of organization when business was in the doldrums in 1921. The Equitable Sales Company then was self-supporting and now is making a profit which is significant of the possibilities of merchandising when it is carried on in a businesslike manner.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Cash Value of Power-Factor Correction

To the Editors of the Electrical World:

I was a little disappointed in an article contained in the Nov. 4 issue of the *Electrical World* entitled "Cash Value of Power-Factor Correction." I think the figures given at the bottom of the right-hand column on page 981 are wrong. The entire coal used for generating power in the example cited is not increased 1.56 times. The losses in the line would be increased 1.56 times with an 80 per cent power factor, but the coal required to supply this extra loss would be no more per kilowatt than that required to generate the general output of the station. I am somewhat afraid that the statement as printed in the *Electrical World* will be accepted as a fact by many of the smaller companies, while to me it is clearly an error.

GEORGE B. LELAND,
Stamford Gas & Electric Company, Stamford, Conn. General Manager.

To the Editors of the Electrical World:

In the Nov. 4 issue of the *Electrical World* there is an article by Fred C. De Weese entitled "Cash Value of Power-Factor Correction." This article is very interesting and timely, but there are a few important points on which, I believe, Mr. De Weese is in error.

In the first column of the article, under the subtitle "Present Methods Unsatisfactory," he states that it requires 56 per cent more copper to transmit a given load at 80 per cent power factor than it does at 100 per cent power factor. This statement is true enough if we consider that the economic wire size is in proportion to the power loss in the line. However, this assumption is not correct, as is apparent from Kelvin's law. The economic size of wire for a given delivered load is proportional to the current, or, in other words, inversely proportional to the power factor, instead of inversely proportional to the square of the power factor. Of course, this statement does not consider the effect of regulation, but in the majority of practical cases, if the transmission line is the correct economic size, it is large enough for reasonable regulation.

A table on page 981 also would apparently assume that the economic size of copper is proportional to the square of the current, and the last paragraph on page 982 seems to be also in error.

P. D. JENNINGS,
Puget Sound Power & Light Company, Seattle, Wash. Assistant Engineer.

The above letters were submitted to Fred C. De Weese, the author of the article referred to, for comment. Mr. De Weese's reply follows:

To the Editors of the Electrical World:

In the criticism by George B. Leland of a statement contained in my article on "Cash Value of Power-Factor Correction" he says: "The losses in the line would be increased 1.56 times with an 80 per cent power factor, but the coal required to supply this extra loss would be no more per kilowatt than that required to generate the general output of the station." This is absolutely true. The coal per generated kilowatt-hour may even be slightly lower, owing to the fact that the plant may have a better load condition; but Mr. Leland evidently overlooked the fact that the statement reads: "The amount of coal required to *deliver* a kilowatt-hour at the lower power factor is $4 \times 1.56 = 6.24$ lb.

In the absence of tests it is necessary to make assumptions to have a basis to work from, and in this case I have assumed the transmission losses to be 10 per cent of the generated power, and the point I am trying to convey is made very clear by the following:

If the coal required to deliver a kilowatt-hour at 100 per cent power factor is 4 lb. and the transmission losses are 10 per cent of the generated power, the coal per generated kilowatt-hour will be 3.6 lb., and as we have an additional generation of 111 kw. to make up the losses at the lower power factor, or $198 + 111 = 309$ kw., the coal in the first case will be $198 \times 3.6 = 713$ lb. and in the second case $309 \times 3.6 = 1{,}113$ lb. The power delivered in each case is 178.2 kw.; then we have $713/178.2 = 4$ lb., and $1{,}113/178.2 = 6.24$ lb.

Referring to P. D. Jennings' criticism, I will say that the article shows only the actual copper losses at the various power factors and does not take into consideration the economies of design.

There is one thing that we must face and that cannot be sidetracked, and that is the I^2R losses. It takes actual fuel to make up these losses, and in many cases on small wire lines, with a very great drop in power factor, the I^2R losses may be greater than proportional to the square of the current, because the resistance is higher from the heating of the increased current.

In the second paragraph of Mr. Jennings' letter he says: "The economic size of wire for a given delivered load is proportional to the current." This law holds good only with a constant load.

The table on page 981 does not assume that the economic wire size is proportional to the square of the current, but shows the actual copper losses for a given delivered load at the various power factors. It is to be noted that the statements referred to at the beginning of the second paragraph and the end of the last paragraph of Mr. Jennings' letter are in line with the calculations as shown in the table on page 981.

FRED C. DE WEESE,
Eastern Minnesota Power Co., Pine City, Minn. General Superintendent.

Advertising Electricity by Radio

To the Editors of the Electrical World:

It appears to me that radio broadcasting can and should be used to acquaint the American public with the many inherent advantages of applied electricity. An organized effort, however, is required to do this efficiently. The plan would benefit the industry and the country as well. Furthermore, if not overdone, it would be a novel and acceptable form of advertising.

As a prelude to the usual method of entertainment offered, each broadcasting station could furnish a short, interesting and instructive talk on the proper application of electrical energy for light, heat and power, outlining the advantages to be derived from each. The talks could be furnished by a group of interested manufacturers, each talk dealing with only one subject at a time and being of as popular a nature as the subject will allow.

When public instruction in this manner in other fields of endeavor is apparently acceptable, there seems to be no reason whatever why the industry which is fostering the development of radio could not take advantage of this method of advertising. The National Electric Light Association, in co-operating, might here find an opportunity to create good will toward the central station.

Salem, Mass. JOHN J. BROPHY.

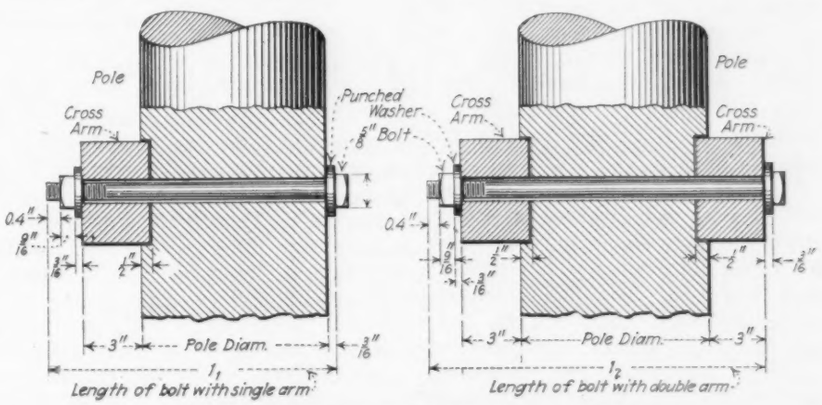
Industrial and Station Practice

Installation, Operation, Test and Repair of
Generating and Distribution Equipment and Methods of Economically Utilizing
Electrical Energy in Mills and Factories

Crossarm Bolt Lengths for Various Poles

WHEN estimating material required for wooden-pole line construction it is usually necessary to determine the number and the proper lengths of the bolts to be used for clamping the cross-arms to the poles. The required number of these bolts is easily computed, but the suitable lengths are not so easy of determination. The proper bolt length varies with the size of the pole and also (because poles taper) with the position of the arm on the pole. Because of these two variable factors it ordinarily requires considerable time to calculate the proper bolt lengths. If the bolt lengths are not thus carefully estimated, they will probably be either too long or too short, with consequent waste or delay. From the accompanying table the proper lengths of bolts for the various standard-size poles and for the different gains with both single and double arms may be read directly.

The first four double columns show the proper bolt lengths for red and white cedar poles having tops of different circumferences based on the National Electric Light Association classifications. In the fifth double column are shown the proper bolt lengths for the National Electric Light Association and the Western Red Cedar Association poles of class A and class AA respectively. These two classifications both specify the same circumference for the pole top but use the different class letters noted to designate the poles. In the sixth double column the Western Red Cedar Association classification is shown as the National Electric Light Association classification does not include poles of this circumference.



DETERMINING PROPER LENGTH FOR A CROSS-ARM BOLT

The elements of detail which are factors in the determination of proper cross-arm bolt length are shown in the illustration. The bolt lengths of the table are based on the average taper of white cedar poles. For class A white-cedar poles this taper is (according to standard specifications) about 1 in. for each 5 ft. of pole length. For red-cedar poles the taper is only about ½ in. per 5-ft. length.

For certain of the gains two different bolt lengths are given. The greater length should be employed if the poles are "running full" or if the taper is considerable, as with white-cedar poles. If the poles are "running scant" or if the taper is slight—as with red cedar—the shorter bolt length may be used. The shorter bolt lengths are very nearly the exact theoretical lengths, based on perfectly circular section and uniform taper as given in the standard pole specifications. However, since in practice poles do not always run uniform, it will be safer to employ the longer bolt length for the poles just described. The shorter lengths allow a surplus (distance bolt extends beyond nut) of 0.4 in.; if the longer-lengths bolts are used, the surplus may be 1 inch.

Other detail assumptions which were employed in computing the bolt lengths of the table are: The center of the first gain is 12 in. vertically from the pole top. The vertical distance between centers of gains is 24 in. The cross-arm thickness is 3½ in. The bolt diameter is ⅝ in. The gains are ½ in. deep.

L. D. MOORE,
Electrical Engineer.
Missouri Pacific Railroad Company,
St. Louis, Mo.

LENGTH IN INCHES OF CROSS-ARM BOLTS WHICH SHOULD BE USED FOR CEDAR POLES OF DIFFERENT CLASSIFICATIONS

	National Electric Light Association Specifications								N.E.L.A. and Western Red Cedar Assoc. Specifications		Western Red Cedar Assoc. Specifications	
	Red Cedar E. White Cedar D. 17-in. top		Red Cedar D. White Cedar C. 18½-in. to 20-in. top		Red Cedar C. White Cedar B. 22-in. top		Red Cedar B. White Cedar A. 24-in. to 25-in. top		Red Cedar A. (N.E.L.A.) Red Cedar AA. (W.R.C.A.) 28-in. top		Red Cedar AAA. 30-in top	
Gains	Single-Arm	Double-Arm	Single-Arm	Double-Arm	Single-Arm	Double-Arm	Single-Arm	Double-Arm	Single-Arm	Double-Arm	Single-Arm	Double-Arm
First	10	13	11	14	12	15	13	16	14	17	*14 15	18
Second	10	13	11	14	12	15	13	16	14	17	15	18
Third	11	14	*11 12	15	*12 13	16	*13 14	17	*14 15	18	15	18
Fourth	11	14	12	15	13	16	14	17	15	18	*15 16	19
Fifth	*11 12	15	12	15	*13 14	17	*14 15	18	*15 16	19	16	19

* Use short-length bolts where pole circumferences are scant or taper slightly as with Western Cedar. Use longer-length bolts where circumferences are full or taper considerably, as with white cedar.

Locomotive Batteries

STANDARDS adopted by the Electric Power Club denote that the capacity of storage batteries for locomotives shall be based on a six-hour rating. Trays for locomotive batteries of the lead-acid type are to be constructed with sides not less than ¾ in. thick, ends not less than 1 in. thick, and bottoms not less than 1 in. thick.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Production Increased 25 per Cent by Better Lighting

THE production of finished spindles has been increased 25 per cent by the substitution of directed illumination for daylight in the textile-spindle shop of Johnson & Bassett, Worcester, Mass., manufacturers of wool-spinning machinery. After each grinding operation the spindles need to be straightened. This operation, requiring the utmost skill, is performed by revolving the spindle on a stand by hand, noting the minute variations from normal true revolution and correcting them by placing the spindles on wooden blocks and striking with a brass hammer. Each time a spindle is straightened a workman spends from two to five minutes upon it.

Until the lighting layout was improved four men worked at rough straightening, employing daylight. At times an ordinary low-wattage lamp was used. The finish straightening, however, could not be done satisfactorily under conditions of varying daylight. The workman used shades and endeavored to keep all direct daylight from the spindle except from one direction. When ordinarily dark afternoons came it was necessary to suspend work entirely. This was because the ordinary lamp, no matter where placed, caused a red line reflection the entire length of the spindle, and work could be done but a short time under such conditions.

A temporary angle reflector was hung from the ceiling at the left side of the work. A 150-watt blue "Mazda" lamp was used. As soon as the light was turned on the direct rays showed too strongly. A silvered reflector cap diffuser was taken from one of the old general lighting units and placed over the side and end of the blue bulb, the cap shading in the direction of the work, and then the whole fixture hung to deliver the best light.

The results were remarkable. The light was soft, strong, broad on the spindle, non-glaring and with no sharp reflections. It was immediately decided to make it permanent. An adjustable-arm ball-and-socket ceiling fixture was installed and the light held rigidly where it best suited the workmen.

The finish straightener now works under the artificial light all day long to the exclusion of any shadow-casting daylight. Instead of maintaining that artificial light could not be used at all for straightening, his ideas and those of every one in the plant are now changed about lighting. The old general lighting units, although not of the approved RLM type, were cleaned, relocated and hung higher, and a bowl enameled lamp was used resulting in a very even distribution of light.

At this plant all production centers on the finish straightener. As a result of his being able to work continuously and using artificial light whether the sun shines or not, production has easily been increased 25 per cent. These are figures ascertained by the management after comparing monthly outputs.

W. S. MOWRY,
Power Salesman.
Worcester Electric Light Company,
Worcester, Mass.

The Elasticity of Pipe Bends

Graphical Determination of Several Standard Bends Represented —Bends of Larger Dimensions Than Those Ordinarily Used Are Recommended

IN SELECTING the proper size and shape of pipe bends to care for a given expansion and in determining the force exerted by a bend in a given state of deflection the three accompanying charts will aid materially. These charts were presented by Sabin Crocker* and Sterling S. Sanford* in a paper presented before the annual meeting of the American Society of Mechanical Engineers on Dec. 4 to 6 at New York. They are the result of careful mathematical study and exhaustive tests and should prove of value to power-plant engineers.

The bends considered are the quarter-bend, U-bend, expansion U-bend and double-offset expansion U-bend with the forces applied as shown in the small figures in the illustrations. The forces and stresses set up in bends made up of pipe sizes up to and including 20 in. and bent to radii up to and including 120 in. may be read from these graphs without the necessity of solving complicated formulas. In general, bends of larger dimensions than ordinarily used are to be recommended. Results as obtained from the charts are said to be on the side of safety. In some cases the bends tested showed greater flexibility than was anticipated.

DETERMINATION OF MAXIMUM BENDING STRESS

The maximum bending stress in the pipe wall of the bend for any expansion in the pipe line which must be cared for is shown in Fig. 1. Inasmuch as the stress is proportional to the outside diameter of the pipe for any deflection or expansion of the bend, and is independent of its weight, this diagram serves for all weights of pipe. The diagram is drawn up for 8-in. pipe, and values for that size may be read directly. For instance, an 8-in. expansion U-bend, formed to a radius of 60 in. and required to take up an expansion of 0.7 in. in the pipe line, would have a maximum bending stress set up in it of 5,380 lb. per square inch.

A sample problem will indicate the method to be used for other sizes of pipe. Since the stress is proportional to the diameter of the pipe, the value of the stress for any size of pipe may be obtained after finding the stress in an 8-in. pipe. The proportion between stresses can be made directly on the diagram by following the radial lines diverging from its lower right corner.

Problem. A 12-in. double-offset expansion U-bend having a radius of 90 in. is to take up an expansion of 1 in. Required, the maximum bending stress in the bend.

From the intersection of 1 in. on the deflection-expansion scale and $R = 90$ in., extend horizontally to the vertical line under 8-in. pipe, which is referred to as the "base line," and then obliquely (with a line passing through lower right-hand corner) until under 12-in. pipe on the upper scale as shown by the arrows on Fig. 1. The result is 2,040 lb. per square inch.

Since the stress is directly proportional to the displacement, this diagram may be used for expansion values which fall beyond its range by multiplying both stress and displacement scales by the same factor. For instance, if a 5-in. expansion is to be considered, the stress for an expansion of 1 in. should be read on the graph and multiplied by five.

The forces set up in the pipe line when pipe bends are used to take up the expansion are shown in Figs. 2 and 3. As these relations are func-

*Engineers with the Detroit Edison Company.

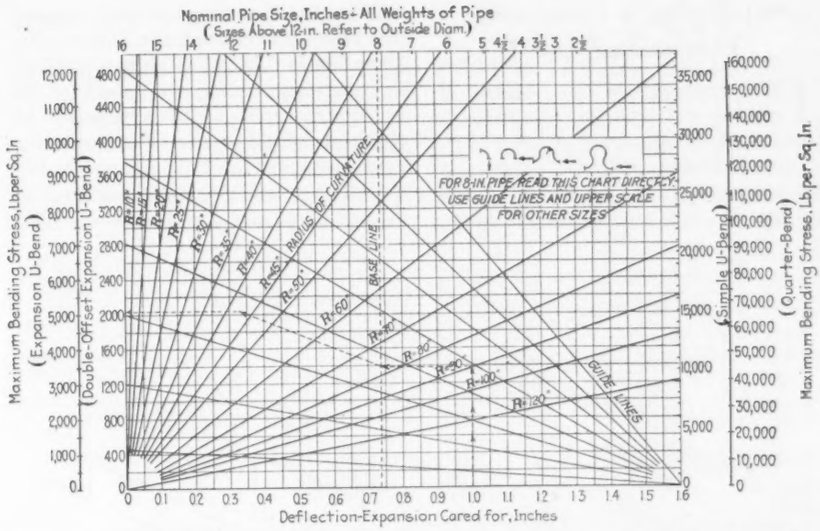

Nominal Pipe Size, Inches - All Weights of Pipe
(Sizes Above 12-in. Refer to Outside Diam)
Maximum Bending Stress, Lbs per Sq. In
(Expansion U-Bend)
(Double-Offset Expansion U-Bend)
(Simple U-Bend)
(Quarter-Bend)
Maximum Bending Stress, Lb per Sq. In
FOR 16-IN. PIPE READ THIS CHART DIRECTLY.
USE GUIDE LINES AND UPPER SCALE
FOR OTHER SIZES.
RADIUS OF CURVATURE
BASE LINE
GUIDE LINES
Deflection-Expansion Cared for, Inches

FIG. 1—STRESS VERSUS DISPLACEMENT FOR VARIOUS SHAPES AND SIZES OF PIPE BENDS

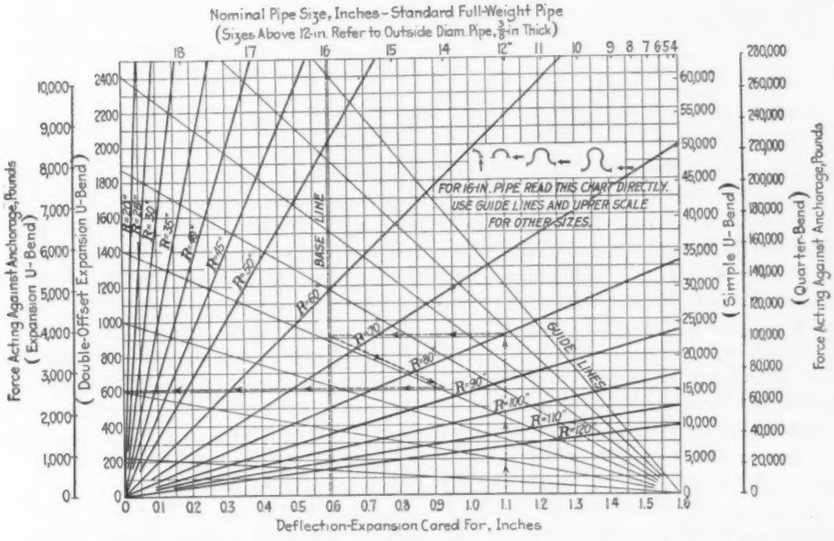

Nominal Pipe Size, Inches - Standard Full-Weight Pipe
(Sizes Above 12-in. Refer to Outside Diam. Pipe, ⅜ in Thick)
Force Acting Against Anchorage, Pounds
(Expansion U-Bend)
(Double-Offset Expansion U-Bend)
(Simple U-Bend)
(Quarter-Bend)
Force Acting Against Anchorage, Pounds
FOR 16-IN. PIPE READ THIS CHART DIRECTLY.
USE GUIDE LINES AND UPPER SCALE
FOR OTHER SIZES.
BASE LINE
GUIDE LINES
Deflection-Expansion Cared For, Inches

FIG. 2—DISPLACEMENT VERSUS FORCE EXERTED ON PIPE BENDS USING STANDARD PIPE

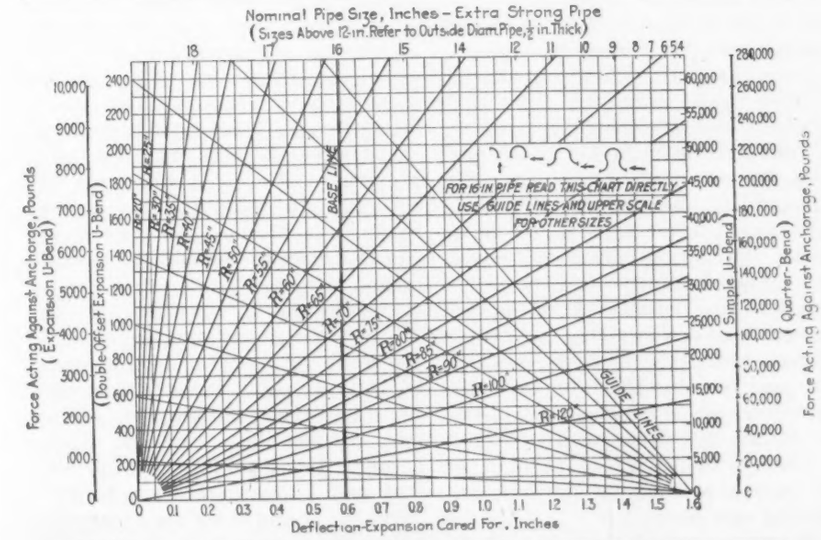

Nominal Pipe Size, Inches - Extra Strong Pipe
(Sizes Above 12-in. Refer to Outside Diam. Pipe, ½ in. Thick)
Force Acting Against Anchorage, Pounds
(Expansion U-Bend)
(Double-Offset Expansion U-Bend)
(Simple U-Bend)
(Quarter-Bend)
Force Acting Against Anchorage, Pounds
FOR 16-IN. PIPE READ THIS CHART DIRECTLY.
USE GUIDE LINES AND UPPER SCALE
FOR OTHER SIZES.
BASE LINE
GUIDE LINES
Deflection-Expansion Cared For, Inches

FIG. 3—DISPLACEMENT VERSUS FORCE EXERTED ON PIPE BENDS USING EXTRA STRONG PIPE

tions of the moments of inertia of the pipe sections, the internal diameters affect the results, and Fig. 2 has been drawn for "standard weight" and Fig. 3 for "extra-heavy" pipe. These diagrams are for 16-in. pipe, and values for this size may be read directly. The scale of pipe sizes at the top of diagram is laid off according to the moment of inertia of the pipe section, as the force to produce a given deflection in the bend is proportional not to the diameter, but to the moment of inertia of the pipe.

After finding the force existing for a given deflection in the 16-in. pipe, the value for any other size of pipe may be obtained by using the radial lines diverging from the lower right corner and the vertical base line under 16-in. pipe for making the proportion. The solution for a sample problem is indicated by the dash lines in Fig. 2. A double-offset expansion U-bend made of 14-in. O.D. pipe, $\frac{3}{8}$ in. thick, formed to a radius of 80 in., is required to take up an expansion of 1.1 in. in the pipe line. From the diagram, the force acting against the pipe anchorage is 610 lb.

Since the force is directly proportional to the displacement, these diagrams also may be used for values which fall beyond their range by considering both force and displacement scales as multiplied by the same factor. It should be noted that in using these diagrams the pipe size refers to the size of pipe used in the bend and has nothing to do with the size of pipe in the rest of the line.

The limits of safe expansion values for pipe bends as commonly quoted in engineering texts and handbooks are apparently correct only for the double-offset expansion U-bend. For the other shapes the published values are much in excess of those given here. Mr. Crocker and Mr. Sanford contended that these limits should be revised to agree with the formulas which are presented in their paper and from which the charts were calculated, for unless the published tables are used with large factors of safety, the forces and stresses existing in pipe lines will be excessive and dangerous.

In the discussion following this paper attention was directed by at least two speakers to apparent oversights that make the calculated results differ from test results. The advisability of considering expansion loops made of straight pipes was suggested by a few speakers. Some

questions were raised regarding the effect of pressure and temperature on the flexibility and stress in bends.

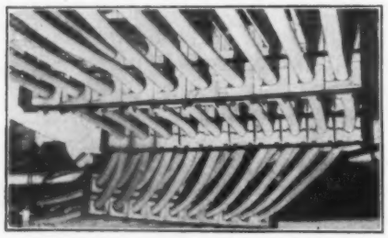
W. B. Campbell contended that some of the conclusions from actual tests are not accurate because they are based on ideal conditions. This was carried farther by R. Cramer, who said that the assumption that the neutral fiber runs through the center of the pipe bend does not result in entirely accurate conclusions.

Another speaker called attention to some U-bends which did not allow the deflection which he had calculated, whereas some double offset expansion U-bends allowed more than twice the deflection. This speaker contended that designers need not fear ripples or buckling on the inside of pipe bends since they reduce stress in outside fibers and increase flexibility. Seamless tubing was urged for bends requiring large-diameter pipe, because with its use there is not the danger of rupturing the outside of the bends.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Sectional Cable Support Saves Space

TO FACILITATE handling cables in the substation of the Travelers Insurance Company at Hartford, Conn., served by the Hartford Electric Light Company, the convenient suspension frame illustrated herewith is used. Twenty cables of a size up to about 500,000 circ.mil can be accommodated in an insulator-supporting structure 40 in. long, 11 in. high and built of angle irons and



OVERHEAD STRUCTURE THAT AIDS IN HANDLING CABLES

iron strap. Each cable is held in position by two inverted L-shaped pieces of porcelain set into the frame side by side and in two horizontal rows, the frame being assembled of 2-in. angles at the top and sides, with intermediate sections composed of 4-in. bars ½ in. square bolted to vertical bars ½ in. thick by 1 in. wide.

D. A. READ,
Assistant Secretary.
Travelers Insurance Company,
Hartford, Conn.

Supplying a Constantly Increasing Load

THE problem of the yearly increase of load on distribution lines and short transmission lines without undue voltage drops and power loss may be satisfactorily solved by such curves as are shown in the accompanying illustrations. In general, the growth of any electric property closely approximates a geometrical progression of the form $y = ax^n$ where y = peak load, kilowatt-hours per year or number of consumers. a = initial value of peak load, etc. x = 1 plus annual percentage increase. n = time element, or number of years.

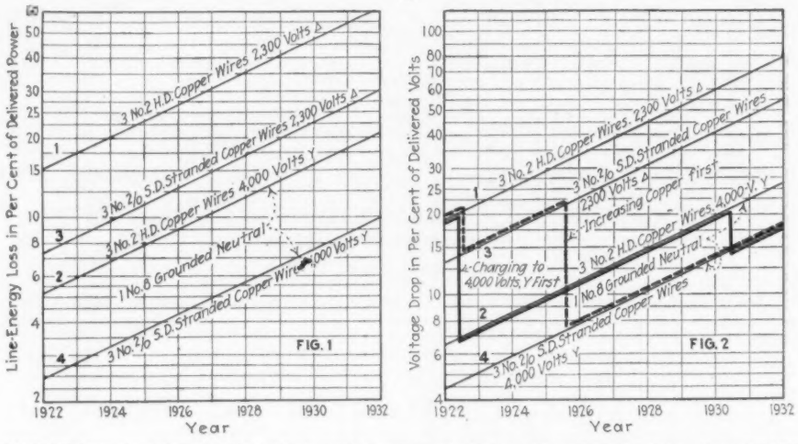
This means that the load n years from now will be equal to the present load multiplied by "1 plus annual percentage increase in load," which increase has first been raised to the nth power.

If the logarithm of the load, or the log of any function of load, is plotted against time, the resultant curve is a straight line. Semi-logarithmic plotting paper makes this curve particularly easy to construct.

Voltage drop in a short transmission line or distribution line is a function of the current, which in turn varies directly with the load. Hence plotting the logarithm of voltage drop against time gives a straight line curve. Knowing the present load and applying the proper annual percentage increase, we may compute the line drop for two different years and draw a straight-line curve through these points.

Energy loss is also a function of the current and may be similarly calculated and plotted.

We have applied this principle to show the voltage drop and energy loss in the distribution line supplying Harvey's Lake from Dallas, Pa. This line is 6.78 miles long, with conductors spaced the equivalent of 25 in. apart, and supplies energy at three-phase, 60 cycles. The maximum load measured in 1922 has been 123 kw. The power factor is assumed at 90 per cent and the annual load increase at 15 per cent. With these data the voltage drop and the energy loss were calculated for various conditions of wire size and line voltage. The curves shown are plotted from these computations and apply to this line. While these curves are specific and apply only to this particular line, the method is fundamental and the same principles may be used to plot similar curves.


Line-Energy Loss in Per Cent of Delivered Power
3 No.2 H.D. Copper Wires 2,300 Volts Δ
3 No.2 H.D. Copper Wires 4,000 Volts Y
3 No.2 H.D. Copper Wires 2,300 Volts Δ
3 No.2 o/o S.D. Stranded Copper Wires 4,000 Volts Y
1 No.8 Grounded Neutral
3 No.2 o/o S.D. Stranded Copper Wires 4,000 Volts Y
FIG. 1
Year
Voltage Drop in Per Cent of Delivered Volts
3 No.2 H.D. Copper Wires, 2300 Volts Δ
3 No.2 o/o S.D. Stranded Copper Wires
2300 Volts Δ
Increasing Copper First
A-Changing to 4000 Volts, Y First
3 No.2 H.D. Copper Wires, 4000 V. Y
1 No.8 Grounded Neutral
3 No.2 o/o S.D. Stranded Copper Wires
4,000 Volts Y
FIG. 2
Year

CONDITIONS OF INCREASING LOAD FROM YEAR TO YEAR ON DISTRIBUTION AND SHORT TRANSMISSION LINES AIDED BY GRAPHICAL STUDY

The energy loss in per cent of delivered power is plotted against time for four conditions in Fig. 1. Curve No. 1 is drawn for No. 2 B. & S. gage hard-drawn solid-copper wire operating at 2,300 volts delta. Fig. 2, curve No. 1, shows the voltage drop in per cent of delivered volts for the same conductors operating at the same voltage, as measured at the receiving end. The initial point of these curves depends upon the value of current for 1922 and upon the constants of the line. The slope of each curve is the same and is dependent upon the annual per cent increase in load.

Changes in line constants alter the initial position or starting point of the curve but do not change its slope, so but one point need be computed for other types of line construction and parallel lines can be drawn through these points. Curves Nos. 2, 3 and 4 are therefore parallel to curve No. 1 and show the energy loss and voltage drop to be expected in the future if the line is operated at

4,000 volts Y, changed to No. 2/0 copper, or changed to No. 2/0 copper and operated at 4,000 volts Y.

The writer has found this curve sheet an excellent way to illustrate the advantages of raising the distribution voltage on this particular line from 2,300 volts delta to 4,000 volts Y. It is felt that this method has a wide application to similar problems.

The accuracy and value of this method depend upon the following:

The initial or starting point must be correctly chosen, and if possible the curves should run back several years. Where past loads are not available, the present maximum load should be determined with curve-drawing ammeters and the voltage measured at the consumer's meter. If the voltage is found to be abnormally low, the initial load figure should be increased by reference to performance curves for "Mazda" lamps, induction motors or whatever devices comprise the principal load.

The line constants must be accurately determined. The size of wire, spacing and total length from origin to load center must be known or closely estimated.

The annual increase in load must be carefully chosen to suit local conditions. Where past load records are available the annual percentage increase may be taken as the average of these figures. Otherwise the engineer must use his own judgment, based upon conditions found in similar territory.

Any voltage drop may be set as the critical or limiting value. Assuming that the sending voltage can be increased so that 10 per cent buck or boost regulators will compensate for the line drop, we may call 20 per cent the critical value, as shown in Fig. 2. Whenever one of the voltage-drop curves crosses this critical value we shall have either to increase the size of conductor or to raise the voltage. The heavy zigzag dashed line shows the result of increasing the size copper first, and the solid line the result of changing to 4,000 volts Y first.

After analyzing the curves the next step is to estimate the cost for each solution, and in the particular case noted it was found cheaper to install new transformers and a fourth wire for the grounded neutral, changing to 4,000 volts Y, than to increase the size of copper to No. 2/0.

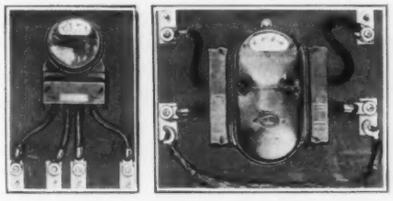
R. E. CURTIS,
Distribution Engineer.

Luzerne County Gas & Electric Company,
Kingston, Pa.

Safely Jumping Large Self-Contained Meters

USUALLY when a meter setter installs a large-capacity meter he is more concerned with leaving a neat job than he is with the difficulties of the testers who come after him. But a consideration of these difficulties and the adoption of methods to overcome them will be amply repaid in the time saved by the tester in jumping the meters and the lessened liability to short circuits with their attendant danger and interruption of service.

The manner in which meters may



RUGGED TERMINALS FOR TESTING SELF-CONTAINED METERS

be set to avoid short circuits is shown in the accompanying illustrations. A short circuit never occurred while these meters were under test. The pictures were taken with the meters mounted on a box after they were removed to permit alterations to an installation. Originally they were mounted together on a slate panel, all leads being behind the panel, and as the Connecticut Light & Power Company, to which the installation belongs, does not supply back-connected meters, some plan was required which would give short flexible leads in front. This was accomplished in the following manner:

Copper studs $\frac{5}{8}$ in. in diameter threaded their entire length were brought through the panel and through pieces of busbar, 3 in. x 2 in. in size, and made tight with nuts on front and back. The meter wire was bent and lugs were attached so that one lug slipped over the stud easily and was held in place by a nut while the other was fastened in the meter. To provide means for jumping the meter, as is shown in the accompanying illustration, a piece of $\frac{5}{16}$-in. copper rod was sweated into the bar, allowing $\frac{1}{4}$ in. to project on the bottom to keep the bar from turning when the nuts were made up. Jumpers were put on without disturbing the meter wires, after which the top nut on the stud and the two screws in the meter terminal were removed and the meter wire was taken out. The meter on the left of the illustration is a single-phase, three-wire instrument, while that on the right is a three-phase, three-wire meter.

FIELD EDITOR ELECTRICAL WORLD.
Boston, Mass.

Light Tripod for Handling Subway Transformers

FOR the purpose of handling subway-type transformers the collapsible steel tripod shown in the accompanying illustration has been constructed by the Northwestern Electric Company of Portland, Ore. The leg swings in against the crossbars supporting the winch, allowing the tripod to be placed in against the side of a truck and easily transported from place to place. The tripod is 11 ft. high with a leg spread of $4\frac{1}{2}$ ft. at the base. It is constructed of $2\frac{1}{2}$-in. angle iron, and the weight, including the winch, is approximately 200 lb. The winch is made up of a drum of $4\frac{1}{2}$-in. diameter, 10-in. gear and $2\frac{1}{2}$-in. pinion, having a tooth ratio of 62 to 16. Three-eighth-inch stranded-steel rope is used with a set of double blocks.

Standard 2,400/240/120-volt subway-type transformers up to 75-kw. rating are readily handled with this equipment, and the leverage ratio is such that much larger transformers

COLLAPSIBLE 200-LB. TRIPOD USED FOR HANDLING SUBWAY TRANSFORMERS

could be easily handled. By making use of a second-hand winch this tripod was constructed at a total cost of about $100.

E. F. PEARSON,
Electrical Engineer.
Northwestern Electric Company,
Portland, Ore.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Store Lighting as a Source of Income

Great Opportunity Presented for the Central-Station Company to Gain Additional Load Which Will Bring in Profitable Revenue Almost Immediately

By J. J. Kirk and W. E. Underwood
Store-Lighting Committee, Lighting Sales Bureau, N. E. L. A.

SOME idea of the revenue-earning value of store and commercial lighting may be gained from the known demand for incandescent lamps for commercial purposes and from the generally accepted figures as to the amount of central-station load and income represented by lighting as against power load.

Approximately 47 per cent of the incandescent lamps manufactured in 1922 were required for store and other commercial lighting. The proportion for 1921 lamp demand was not greatly different. If it is true that lighting load, as a whole, consumes 23 per cent of the central-station output and represents 59 per cent of the central-station gross revenue, we may reasonably surmise that 47 per cent of this is in the commercial lighting field. In short, then, commercial lighting is roughly 10 per cent of the central-station load and represents 25 per cent of the gross income. It should be stated that the figure of 47 per cent of lamps manufactured does not mean the number of lamps made but their dollar value, which corresponds rather closely to their ratings in watts and therefore to the central-station load they produce.

The store-lighting load and the resulting income are considerably greater than the residential lighting or industrial lighting demand. This one field is without doubt at the present time the best big-volume profit maker within the central station's purview. It is so good that it merits especial attention and specialized effort in expanding and enlarging it to its maximum as speedily as possible.

Residential lighting demand has increased during the last two years at a rapid rate owing principally to an excessive housing shortage. Not only has the building rate been rapid, but very many old homes have been wired. Even with this boom, however, residential lighting still plays second fiddle to commercial lighting in total kilowatt-hour load and annual revenue. The reason is easy to comprehend. The average store, according to Commonwealth Edison statistics, has a connected load of 2 kw. and a load factor of five hours a day. The average home has a connected load of 762 watts and a load factor of one and one-half hours per day. Then remember that 40 per cent of the home load is in appliances and that a rather small part of the connected load in the home is in use at any one time, while the entire store lighting load is effective during the major part of five hours per day. With these facts in mind it is obvious that it takes a lot of homes to equal one store when it comes to a consideration of central-station revenue.

The industrial lighting field is excellent but not so large as store lighting. With factories working at 60 and 70 per cent of capacity and with comparatively few as yet running night shifts, the lighting income from this source is much smaller than it once was or than it may be again when prosperity has climbed a few rungs higher up the ladder.

The Opportunity for Expansion

To stimulate home lighting demand—to accelerate the speed with which homes are wired or to get people to use more lamps or higher-wattage lamps or more appliances—is a rather slow process. It must be done chiefly by a program of advertising, education and easy-payment financing. There is not so much opportunity here for the central-station solicitor immediately to put more profitable load on the central-station lines. The field is too broad for the lighting-sales specialist to pay his way.

The recent stringency and the need for the average factory executive to pare his expenses has made it very difficult to sell more light in this field.

But in the store-lighting field the central-station lighting salesman has found things to his taste. Merchants everywhere for the past year have been in a most favorable frame of mind toward good illumination. It is almost impossible to find a merchant who will not readily admit the importance of illumination in drawing and holding trade. And competition is keen—a big factor in making the merchant eager to invest in anything within reason that will make his store conspicuous and bring new buyers into it.

Getting Into Action

It has taken a long time for the central station to realize that fundamentally its problems are the same as those of any other manufacturer, first to make something and then to dispose of it in the best market. For years we have been so beset with tremendous engineering problems that the marketing of kilowatt-hours has been slighted. We were so eternally busy trying to manufacture energy at the lowest possible cost that we forgot the equally vital need of selling it at a profit.

The start was the realization that load factor had a bearing on profit. Then came the discovery that some kinds of load were more profitable than others, but with these basic facts before them there are still many central stations which are not applying them to the full extent.

A manufacturer of ready-to-wear clothing, of clocks, furniture, or of whatever you please, knows to the fraction of a cent what profit he makes on each commodity. And he chooses certain lines as leaders because they sell rapidly or because of an especially good profit margin. Those are the things that his salesmen try hardest to sell. From time

to time he changes his leaders—switches his main selling effort from one commodity to another because of the season or condition of the market. Why this generally accepted idea in all other lines of business is not more widely followed in the central-station industry is a mystery. Just now store lighting is the obvious leader for the sales endeavor of the central station. It should be a leader, first, because it can be readily sold at the present time; second, because it is a big-volume business, and, third, because it is an extremely profitable business.

Here's a sample of what can be done: In 1921 the Commonwealth Edison Company investigated a thousand stores selected at random. The average illumination intensity for these stores was very low. Only 25 per cent had 5 foot-candles or more. Only 2 per cent had 10 foot-candles or higher intensity. In 1922 a thorough campaign of concentrated sales effort on stores was made in which a standard of 10 foot-candles was aimed at. This campaign added 45.7 per cent to the store-lighting revenue of this central station!

If the lighting level of all Chicago stores can be brought up to the low level of 5 foot-candles, it will add another 32,000 kw. to the central-station load and more than a million dollars to the annual income. Boosting the lighting level of stores to 10 foot-candles will add two and a half million dollars.

RIGHT WAY TO SELL STORE LIGHTING

A recent survey indicates (in percentage) the following general and average condition of store lighting:

	Store-Interior Lighting	Store-Window Lighting
Good	27	10
Fair	43	18
Poor	30	72

Whatever discrepancies there may be in these figures when applied to any particular locality, they at least indicate that really good store lighting either for windows or store interiors is the exception rather than the rule.

Better lighting can most easily be sold to those stores which already have fair or reasonably good illumination. In fact, many of these merchants believe that they have good lighting and are proud of their lighting installations. When it is demonstrated to them that better lighting is possible at no great cost they are the easiest customers to convince.

The lighting salesman who really knows something about store lighting and window lighting and how to improve it, and who is able to figure the cost right on the job, is the one who will sell most successfully. It pays also to pick one good type of store-lighting unit and to concentrate sales effort on it. Carrying a demonstration unit inevitably helps sales. The same may be said for choosing and carrying one type of window-lighting unit.

The average merchant thinks of lighting in terms of profit to his store. He is most easily "sold" on the idea that better illumination, which to his mind always means brighter illumination, will bring more trade. Recent tests on the relation between lighting intensities and the "pulling power" of show windows prove how absolutely right the merchant is in this surmise.

Merchants who have installed better illumination cite many advantages, such as greater profit, fewer returned goods, improved courtesy and more regular attendance on the part of floor salesmen, the sale of slow-moving goods, the speeding up of sales, greater cleanliness and better reputation for the store.

OPPORTUNITY FOR 1923

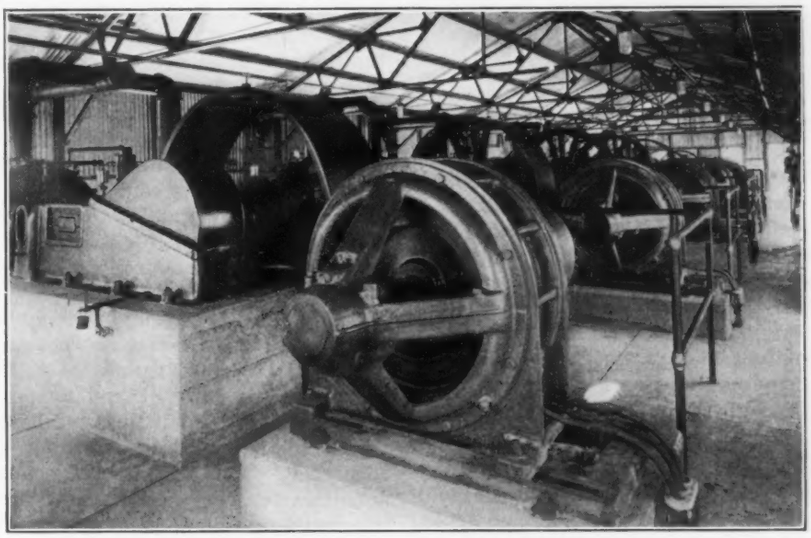
Whatever other opportunities may present themselves in 1923, it seems hardly possible that any more profitable opening for increased central-station income can arise than better store lighting. It is something that any central-station company may cash in upon immediately, and the very best sales season is at hand during the next few months.

Electric Power for Casing Head Gasoline Process

A FURTHER development in the use of electric power in oil-field operations is seen in the complete electrification of a number of casing head gasoline plants in the Midcontinent field. Substitution of electric drive for steam for this purpose is effecting economies as great as those it has already accomplished in oil-well drilling, and, as the nature of the work permits of continual operation at a constant demand for twenty-four hours per day, it offers a very desirable type of load for the central station.

In extracting the gasoline from the natural gas the absorption process is used, whereby the gas is sent through a container under 30 lb. to 50 lb. pressure per square inch, the container being previously charged with naphtha or mineral-seal oil, both products of the crude-oil refinery. The naphtha or heavier oil absorbs much gasoline from the gas as it passes through the container under pressure. If naphtha is used, the resulting product is gasoline as it comes from the container. If the heavier mineral oil is used, the product is distilled and the gasoline taken out as in the ordinary refining process, the mineral oil being returned to the container for further use. The amount of gas necessary to produce a gallon of gasoline varies with the fields. In the Midcontinent fields the yield is from 0.5 gal. to 8 gal. to 1,000 cu.ft. of gas.

The gas is piped into the mains after it has been processed and is used for fuel either in the field or in



COMPRESSOR ROOM OF CASING HEAD GASOLINE PLANT

the cities that are served with natural gas. Its B.t.u. value is not affected by the processing.

Two new casing head gasoline plants belonging to the Chester & Smith Corporation of Tulsa, Okla., have just begun operation with complete electrical equipment at Eastland, Tex. These two plants are processing 20,000,000 cu.ft. of natural gas a day, and the company is adding electrical equipment in all other gasoline plants as occasion presents itself.

The particularly favorable features of motor drive for these plants are found to be low first cost, low maintenance and continuity of service, and, on account of the extremely short drive, much less building space is required than otherwise would be possible for engine-driven compressors of the same size. This latter condition is exemplified most forcibly at Plant No. 108, shown here, where compressors with a total capacity of 10,000,000 cu.ft. of gas per day and a connected load of 1,180 motor horsepower are housed in a compressor building 30 ft. x 100 ft.

The motor-driven compressor equipment and auxiliaries are uniform in both plants. The major equipment at Plant No. 107 consists of four 16-in. x 16-in. x 16-in. duplex compressors, each driven by a 200-hp., 440-volt induction motor; two 12-in. x 12-in. x 12-in. duplex compressors, used for handling noncondensed vapor gases, each connected by short belt drive to a 60-hp., 440-volt induction motor, and the various loading, oil-circulating and water pumps, belt-driven from a line shaft, which in turn is driven by a motor identical with those used on the vapor units. The equipment at Plant No. 108 is identical with that at Plant No. 107, with the exception that this latter plant has five main units.

The transformer bank supplying the compressor plant is situated about 150 ft. away. All wiring is in conduit, and inclosed fuses are used on secondary wiring. Oil switches are used on the compensators. Thus any danger of fire or explosion is minimized.

The main compressors are used for drawing the natural gas from the fields through a series of gathering lines and operate at an average vacuum of 10 in. of mercury at the suction side of the compressor and a discharge pressure of from 28 lb. to 30 lb. per sq.in.

All motors are operated at full load twenty-four hours per day and have been in operation for from three to twelve months with an operating record, based on actual time in service, of from 98 to 99 per cent.

In the case of Plant No. 108 about 10,000,000 cu.ft. of gas is passed through the process per day. The average demand, which is almost constant, is 800 kw., and the plant consumes approximately 20,000 kw.-hr. every twenty-four hours, producing in that time an average of 20,000 gal. of gasoline.

Power is supplied from the distribution system of the Oil Belt Power Company, at Eastland, Tex., which also supplies all commercial and oil field power in the Ranger, Eastland and Breckenridge districts.

News—Its Relation to the Utility*

What a Newspaper Man Sees in the Public Service Company and His Suggestions for Getting the Story Across to the People —News Versus Propaganda

BY BRAINARD PLATT
Assistant to Vice-president, *Courier-Journal* and Louisville *Times*
Louisville, Ky.

I BELIEVE this circumstance of a newspaper man addressing a convention of public utility men in an open convention is unique in Kentucky. Such a case has been slow in coming to this commonwealth as elsewhere. It represents a new alignment of relationship established only after a long struggle by the news-distributing agencies—that is, the newspapers—to humanize the heads of public utilities.

"What is news in relation to public utilities?" The *Courier-Journal* and *Times* "style book" defines news as "that characteristic of any happening which gives to it an appeal beyond the circle of those immediately concerned," and that is as good a definition for you as any. In applying this definition it is necessary for you to classify the corporations and the papers. For instance, what will be a news item in a town of a few thousand to a paper published weekly might not be a news item to a daily paper published in a city of the first, second or third class.

It is the big activities of the utilities that are the obvious news—the building of new units for a plant, the extension of facilities, the development of old policies or the change to new ones, floating a large loan or canceling one, defying a strike or settling a strike, organizing the employees in the union or out, promoting a welfare movement such as was done by the Louisville Railway Company or squelching one, increasing a wage scale or reducing one with or without the consent of the employees, trying a new process for purifying water, getting into new gas fields, reducing the cost of gas or electricity, increasing the rate, discovery of new processes for cheapening production of electricity and so on indefinitely.

It is conceivable that some of what the newspapers and the public would seize as most important news would be pooh-poohed by the company. That might be because the public is the ox that is being gored and the utility is the ox that is sinking in the horn. I say this is conceivable. It is also conceivable that at some distant date all contracts made by utilities with the public will be written in the open. When this is the practice the news the public wants will be the news the companies are willing to give out. It will be the casual item the reporter picks up as he passes along the way of the utilities' head offices. It sounds a little Utopian, of course, but why not hitch the wagon to a star?

THINGS THE PUBLIC WANTS TO KNOW

When that time comes the newspapers would know, for instance, exactly what is in the back of everybody's head when lampblack factories are established in natural-gas territories. They would know without peradventure of doubt just why old-line telephone companies fight independent companies in the newspapers and out and then suddenly lie down with the lambs and purr as they sleep. They would know, too, straight off, why railway companies at first fight the stranger seeking to lay tracks in their midst and then welcome him with open arms.

Please do not understand me to say that such time is not on its way. It is. One of the encouraging signs was the manner in which the Louisville Railway Company handled its

*From an address at the annual meeting of the Kentucky Association of Public Utilities at Lexington, Ky., Dec. 12, 1922.

negotiations with the city when it was seeking to readjust the fare. There were no press agents distributing the news for the company. Reporters were welcomed by the company and the developments were discussed from time to time by the reporters and the railway heads. Each day brought forth its particular item, the building up of which was made easy by the co-operation of those in the railway's employ best able to help. It was possible for the public to follow the negotiations step by step, and that was the public's right.

No talk on news from public utilities would be complete without a word on the universally read news—I mean the accidents and tragedies. The trivialities under the accident classification, of course, need not be considered, but the accidents of consequence are legitimate news always in all kinds of newspapers. Facts should be readily available to newspapers from authentic sources. The reporter should not be required to use rumor and reports. The far-sighted heads of public utilities will put at the disposal of the news gatherer every facility for getting at the facts, no matter who in authority may suffer thereby. Formerly this was not done. Now it is being done more and more. There is a disposition on the part of utilities to accept responsibility where responsibility is justly due, and that state of mind removes much of the reason for suppression and evasion.

It is my idea that newspapers should know news confidentially only that when the release date comes they may be in a position to handle the news more fully. No newspaper and no reporter should accept news in confidence with their hands tied perpetually on that news. Those of you men who have had news dealing with reporters know that they can be trusted; you know that they do not violate confidences.

PROPAGANDA NOT NEWS

In all business publicity there is often difficulty in drawing the line between news and propaganda. News, of course, is welcomed freely to newspaper columns. This should speak for itself. The propaganda should go to the advertising columns properly labeled so that the public will know who and what is speaking. If the utilities fail to see the difference, they can send everything they believe to bear the earmarks of news to the newspapers and the papers will winnow out the news. Undoubtedly you will be visited by representatives of the business office on some of the matter that only the business office can with propriety handle. You will find the advertising columns of the newspapers powerful instruments in your hands if they are used honestly to educate the public. They form an honorable approach toward the public and, used in connection with pure, "honest-to-God" news, running as it develops in the news columns, they help the public to appreciate public utilities as desirable citizens.

A Slogan Contest for New York

TO FOCUS the attention of the public on the value of electric service a contest for a suitable slogan for the industry will be launched on Jan. 1, 1923, throughout the entire State of New York by the Empire State Gas and Electric Association. Announcements of the contest, like that reproduced here, are being sent to every utility in the state with the request that they give it publicity by posting it prominently in their offices and also running the announcement as paid advertising in the newspapers.

Win $50 or More For a Few Minutes' Thought!

$350 in Prizes – 54 Cash Awards

The Empire State Gas and Electric Association offers Four Prizes of $50, $25, $15 and $10 for the four best advertising slogans describing in 10 words or less, the value of Electric Service.

Also $5 each will be paid for all accepted statements of about 100 words, explaining why this Service has such big value. The Association expects to accept *at least 50* such statements in regard to electric service.

Could you get along without Electricity?

Do you realize how much you get out of every dollar you spend for Electric Service?

Your dollar buys something that means easier and better work; more comfort and convenience; higher standards of living; light; heat and power.

Think of a slogan that describes what this Service means to you! Write a short statement, not exceeding 100 words, telling all the things your dollar buys when spent for Electric Service. Send each slogan or statement to us and we will forward it to the Contest Judges.

The four winning slogans and all accepted statements become the property of the Association for use in future advertising. If two or more persons submit the slogan considered the best, second best, etc., each will receive the full amount of the prize offered.

Send in as many slogans and statements as you wish. Write each on a separate sheet of paper with name and address. Copy submitted, cannot be returned.

Contest Closes January 31st, 1923

Prize winners will be notified by the Association as soon as possible after closing date.

We will gladly explain our Service to you, and answer any questions about the Prize Contest.

(Name of Company)

ANNOUNCEMENT OF NEW YORK SLOGAN CONTEST

The slogan contest, which will close on Jan. 31, is the result of the work of the association's advertising committee, which is endeavoring to increase the value of utility advertising by injecting into it more about the fundamental value of electricity as a service. It is felt that advertising effort has been scattered and spasmodic, with the result that the public has come to take the service pretty much for granted. It is the purpose of the committee to concentrate attention first through the contest itself and later through the use of the ideas and material which it produces.

What Other Companies Are Doing

Jefferson, Tex.—The Jefferson Ice & Light Company, under contract with the City Council, has begun installation of twenty-two 250-watt street lights on ornamental iron standards, forming a "white way" for the principal business street, and is also changing street lamps in the residence section from 32-watt to 60-watt units.

Delphos, Ohio—On Saturday, Dec. 9, the Northwestern Ohio Light Company held a successful electrical show which drew an attendance of 800. Electrical appliances were exhibited and "prospect" cards asking for demonstrations were obtained. This large attendance, secured at a time when merchants were attending to the week-end country trade, speaks well for the interest in the show.

Boston, Mass. — Electrical gifts for modern homes were featured in a special Christmas booklet prepared this year for companies under the management of Charles H. Tenney & Company, Boston, and distributed to 56,000 customers taking electrical service from these utilities. The booklets featured Christmas-tree lamps, hollow ware, portable lamps, washers and other articles of convenience and were illustrated through the co-operation of manufacturers and by photographs taken specially for these companies. A "shopping list" on the back cover added a convenient touch.

Lake Geneva, Wis.—Sales of electricity by the Southern Wisconsin Electric company for the twelve-month period ended Sept. 1 showed an increase of 14 per cent in kilowatt-hours sold as compared with the previous twelve months. New customers added to the company's lines averaged an increase of 10 per cent. For the first six months of 1922 the company reported an increase in gross revenue of 16 per cent over the corresponding period in 1921.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press from All Parts of the World

Hydro-Electric Development and Steam Equipment

Surface Condensing Plant and Auxiliaries.—The design of condensers has been greatly improved during the last few years, and the condenser is now one of the most important and efficient units employed in power production. This efficiency is dependent upon the even distribution of the steam over the surface and freedom from eddies and stagnant pockets, the general proportions of the cooling surface, and the quantity of circulating water used. A "Contraflo" surface condenser of English make for use in conjunction with a 10,000-kw. turbine is described. This is designed to condense 106,000 lb. of steam per hour and to maintain a vacuum of 28.7 in. The auxiliary equipment for this condenser is also considered.—*Engineer*, Oct. 20, 1922.

Evaporation: A Study of the Various Operating Cycles in Triple-Effect Units.—A. L. WEBRE.—A general method of discovering the best operating cycle for triple-effect evaporators is described. A heat balance is worked out for a typical case and the type of conclusions which may be reached is indicated.—*Chemical and Metallurgical Engineering*, Nov. 29, 1922.

Generation, Control and Switching

Relations of the Electric Power Industry to the Industrial Corporation.—C. P. STEINMETZ.—A discussion of the economic relations between the electric power industry and the industrial corporations using electric power and producing by-product energy. The author compares the possible economies of central-station production with those of a local isolated power station. With a considerable amount of by-product energy and a local station built to utilize all the by-product energy the power output of the local station may sometimes or frequently exceed the power demand of the industry so that power could be fed back into the central-station system. In other words, sometimes the central station would supply power to the local plant and at other times the local station would return power to the central station. With such a power exchange an arrangement of the charge for power received and credit for the power returned would have to be made, which in itself is a very difficult problem. The author believes that a great step in the industrial development of the country would be taken if the relative economy of a progressive industrial corporation using considerable power and producing considerable by-product energy and an equally progressive electric power corporation could be worked out.—*General Electric Review*, December, 1922.

Transmission, Substations and Distribution

Standardization of All New Equipment for the Reconstructed Coal Mines of France.—G. JAULA.—To insure the most intensive and efficient exploitation of the French coal mines which were destroyed by the enemy, a general electrification progr m was established in 1916 for their reconstruction and future operation. This program is described at length. The three-phase, 50-cycle system has been chosen, with 15,000-volt transmission and 3,000-volt secondary tension. Three-phase oil-immersed, core-type, 1,000-kw. transformers have been installed, three at every mine. All power lines are laid out in underground cables to insure a greater reliability of the energy supply. All oil switches for the 15,000-volt lines are designed for a rupturing capacity of 40,000 kva. and a test voltage of 55,000. In spite of the much higher first cost, the Leonard direct-current system has been chosen as the standard type of electric mine hoist in preference to the direct drive with a three-phase motor. A considerably lower energy consumption, more uniform power demand, better power factor and finer regulation were among the chief factors which led to the selection of the direct-current drive. Asynchronous motors are used for the mine exhaust fans and synchronous motors for all compressors. In all new generating stations the pulverized-coal firing system has been installed.—*Revue Générale de l'Electricité*, Nov. 11, 1922.

Units, Measurements and Instruments

Tensile Properties of Low-Carbon Steel.—H. J. FRENCH.—An investigation to determine the effect of temperature deformation and rate of loading on the tensile properties of low-carbon steel below the thermal critical range. An apparatus for determining tensile properties of metals at high temperatures and the results of tests of several grades of boiler plate from 20 deg. C. to 465 deg. C. are described. The effects of cold and blue work on the properties of these steels throughout the range given are discussed, and in addition some results are given showing the effect of tensional elastic overstrain on the proportional limit at different temperatures and its subsequent behavior with time. Effects of variations in rates of loading and the modified apparatus used for this work are also described.—*Technologic Paper No. 219 of the Bureau of Standards.*

Temperature Coefficient of Insulation Resistance of Rubber-Covered Wire.—The temperature coefficient of insulation was investigated for two kinds of wire, namely with rubber content of 40 per cent grade and 20 per cent grade. The mechanical properties and chemical compositions were tested and analyzed for specimens from eight Japanese manufacturers. The results as stated by the article showed that the temperature coefficient of insulation resistance of the rubber-covered wire not only increases as the rubber content decreases but has also a tendency to increase in nearly proportional relation with the amount of organic substances in rubber compound extracted by various solvents, and that the degree of vulcanization has almost no influence upon the temperature coefficient.—*Researches of the Electrotechnical Laboratory, Tokyo, Japan.*

Illumination

Application of Lighting to Restaurants and Schools.—This issue is devoted to two papers presented at the Swampscott convention of the I. E. S. These are "Lighting for Public Eating Places," by J. L. Stair, and "Practical Applications of the Principles of School Lighting," by H. B. Dates. An abstract of the former paper can be found in the convention report on page 760 of *Electrical World* for Oct. 7, 1922, and an abstract of the latter can be found on page 759 of the same issue. The complete discussion following the reading of the school-lighting paper is included.—*Transactions of the I. E. S.*, November, 1922.

Motors and Control

Application of Electricity in the Manufacturing Industry.—The development of electric logging methods in the lumber industry is considered in this article, which contains an account of skyline logging, in which a steel cable is anchored to the timber on the crest of a hill and the logs are transported to the mill below. Other points considered are the distribution of energy through forests, electric rafting and the advantages of applying electricity to this industry.—*Electrical News*, Nov. 1, 1922.

When to Ground Conduits and Motor Frames.—EDGAR P. SLACK.—The first of a series of articles dealing with when, how and why to ground conduit and motor frames, based on the National Electrical Code requirements. The grounding of motor frames is required for motors operating at more than 150 volts potential and accessible to other than qualified attendants. A further requirement is that when frames are not grounded and the voltage of the circuit exceeds 150 to ground the frames shall be permanently and effectively insulated from ground. —*Power*, Nov. 7, 1922.

Wound-Rotor Connections.—A. C. ROE.—Rotors of slip-ring induction motors are wound in almost the same way as stators. The slight differences from the stator winding are, however, of vital importance. The author points out just what these differences are. He gives figures and diagrams which explain how the connections should be made on any wound rotor. Of special value is a simplified kind of diagram which may be applied to a stator or any other kind of winding.—*Industrial Engineer*, November, 1922.

Heat Applications and Material Handling

Specifications for Welding Wire.—H. G. KNOX.—When the American Welding Society's wire committee undertook to prepare a single set of standard specifications, the diversity of uses and the differences of opinion as to suitable welding wires made the problem a difficult one. It was finally decided to adopt the specifications used by the Navy Department as a guide in preparing the specifications for welding wire. Copies of the welding-wire specifications as they now stand may be obtained from the society. These cover the material, physical properties, nomenclature, chemical composition, recommended sizes, tests and wire for gas and non-ferrous welding.—*Journal of the American Welding Society*, November, 1922.

Handling Material in Automotive Plant.—Tractor operation in the Studebaker Corporation, South Bend, Ind., has accomplished a large saving in productive labor and has also worked admirably with the system of maintaining small banks of material in each department operating, for the reason that it works on a schedule basis entirely and tends to keep the flow of material constant. The trains of materials are made up entirely in the different clearing stations and rough stores. The trucks are lifted from their piles in rough stores and placed in proper order in the making-up aisle, ticketed for transfer and coupled together by the rough-stores men. A description is given of how all the materials are handled by tractor. A complete system of time checking is developed which makes delays very few.—*Iron Age*, Nov. 16, 1922.

Electric Heating by Ironless Induction.—E. F. NORTHRUP.—The author has conducted a series of experimental and theoretical investigations on inductive electric heating which lead up to the present applications of this method with currents of higher frequency than are employed by commercial lighting and power. The fundamental principles to apply in heating inductively with currents of frequencies sufficiently high to make the use of iron unnecessary for increasing the magnetic induction are considered. Details of construction and circuit diagrams are also touched upon. The article is about eleven pages long and gives a comprehensive study of this subject.—*General Electric Review*, November, 1922.

Traction

Some Arguments for Railroad Electrification.—W. J. DAVIS, JR.—Many logical reasons for electrification of steam railroads are given by the author. Several comparisons between steam and electric railroads are made. The accompanying table affords a comparison between steam and electric operation as applying to sections of the main lines of two large railroad systems. Both systems are single-track with the usual percentage of sidings. The length of sections considered is 330 miles for road A and 260 miles for road B. The costs are given in the form of percentages, the basis being the total cost of steam service for the freight traffic. It is assumed that electric power will be purchased in each case. The figures for steam service were obtained from operating records. The costs for the electric system are estimated. It will be seen that the total net savings in operation are 40.38 per cent for road A and 36.57 per cent for road B. Expressed in terms of capital cost, these savings become 16.3 per cent and 17.1 per cent of the net cost of electrification after deducting the replacement value of the steam locomotives. These two cases may be considered as fairly representing the economies to be expected from electrification.—*General Electric Review*, December, 1922.

PERCENTAGE COMPARISON BETWEEN STEAM AND ELECTRIC OPERATION OF RAILROADS FAVORS ELECTRIFICATION

Item	Road A			Road B		
	Steam	Electric	Reduction	Steam	Electric	Reduction
Fuel or power	33.80	27.50	6.30	38.34	32.70	5.64
Locomotive repairs	30.40	10.70	19.70	23.65	8.35	15.30
Lubricants and supplies	2.35	1.41	0.94	2.39	1.44	0.95
Engine-house expense	4.62	0.77	3.85	9.00	2.50	6.50
Enginemen	13.76	6.82	6.94	13.60	8.22	5.38
Trainmen	15.07	8.10	6.97	13.02	7.82	5.19
Maintenance trolley	.....	4.32	*4.32	.....	2.39	*2.39
Total	100.00	59.62	40.38	100.00	63.43	36.57

* Increase.

Telegraphy, Telephony, Radio and Signals

Electric Dictaphone.—K. PERLEWITZ.—The article describes a dictation recorder similar to the types used in America. Instead of using a membrane which is set in vibration by the voice, a specially constructed telephone receiver with a stylus attached to the steel membrane is carried along the axis of the rotating wax cylinder. Very strong magnets in the receiver, in conjunction with a speech-amplifying electron tube mounted within the apparatus, guarantee a reliable and permanently adjusted recorder. The machine is fully automatic, and all operations, as, for example, the change from dictating to listening, are remotely controlled by push-buttons. The telegraphone, as it is called, has a wide use. Owing to its electric recording principle, it can be used to register any telephonic message. It is further possible to have one recording apparatus, installed in a room outside of the offices, made electrically accessible to several dictators, each of whom has only a small transmitter and a double-throw switch on his disk.—*Elektrotechnische Zeitschrift*, Nov. 16, 1922.

Radio Communication.—The December issue of *Q S T* contains several methods for sending and receiving by radio. C. R. Leutz describes a super-heterodyne unit that has given very satisfactory results. A. H. Babccok gives a discussion on the design of a small continuous-wave transformer. In attempting to adapt super-regeneration to short-wave telegraph reception James Wood carried out a number of experiments the results of which are given in an article. Among other subjects covered are continuous wave experiments and results, reception of signals from Europe, description of a spark transmitting set and description of a single-tube super-regenerator, based on the methods that have been employed by E. H. Armstrong.—*Q S T*, December, 1922.

Miscellaneous

Mechanism of Lubrication.—WILLIAM STONE.—An explanation of the principles of lubrication as developed mathematically by Reynolds and Michel and employed by the latter in the design of the Michel thrust and journal bearings. The pamphlet contains thirty pages, illustrated by diagrams and photographs of working models in operation.—*Industrial Australian and Mining Standard.*

Talking Motion Pictures.—E. NESPER.—This article gives an account of different attempts made in Europe to develop a system to synchronize action in a motion-picture film with acoustical performance. In 1918 Seibt perfected a receiving and reproducing apparatus which is free of acoustical distortions. This was accomplished by using inertialess tubes, amplifiers and a newly developed electrostatic telephone. With this arrangement a motion picture is taken on a standard-size film, occupying about seven-eighths of the available picture surface, while on the remaining surface are registered the fluctuations caused by the talking or singing of the actor. Action and speech are in this way registered on the same film simultaneously.—*Elektrotechnische Zeitschrift*, Oct. 26, 1922.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Indiana Supreme Court Sustains Consolidation

The authorization in January last by the Indiana Public Service Commission of the consolidation of seven northern Indiana utility companies into the Indiana Electric Corporation has just been upheld by a decision of the Indiana Supreme Court reversing the finding of the Superior Court of Marion County, which had held that the commission acted illegally. The suit to annul the commission's action was brought by the cities of Kokomo and Indianapolis, the Indiana Railways & Light Company of the former city and the Merchants' Heat & Light Company of the latter being two of the companies merged. Much public opposition to the merger sprang up at the time it was first authorized, and the Mayor of Indianapolis staged a sensational descent of citizens upon the State Capitol.

Southern Power Resumes Full Service

A suspension of the order issued last month by the Southern Power Company curtailing the use of power by various industrial plants, principally cotton mills, took effect on Dec. 20. The curtailment order, or rather request, was put into effect Nov. 27. The users of power co-operated efficiently with the power company in the effort to conserve power and a period of danger was safely passed. Rains have now, it is thought, insured plenty of water for the power plants until next summer at least, and by that time the power company expects to have its new auxiliary steam plants and its new hydro-electric plants in operation.

Two Sets of Books Need Not Be Kept in California

California electric light and power companies which have annual operating revenues of more than $250,000 need keep only one set of books of accounts as the result of an order of the California Railroad Commission establishing a new system of accounting for these corporations. The new system conforms substantially with that of the Federal Power Commission and embodies sound accounting principles and practices.

The greatest departure thus made from the system of accounting which is now in effect is the classification of property on a functioning basis, or on the basis of what it is used for instead of the material it contains. For example, transmission and distribution systems can now be listed as separate accounts instead of jointly with sub-classifications for wire, poles, insulators and the like. Similarly, there will be separate accounts for hydro-electric and steam plants under the new system.

An exception to the new ruling is made by the commission in the case of electric corporations which operate only steam generating plants, transmission and distribution systems or which operate only transmission and distribution systems and also operate gas plants. They may keep their accounts and records during 1923 in accordance with the system now in effect.

Street-Lighting Tables for 1923

FOLLOWING its practice for thirty-four consecutive years, the *Electrical World* has prepared tables showing the proper time for lighting and extinguishing street lamps. The tables for 1923 are now ready, and a copy of them will be sent free to any subscriber upon request to *Electrical World*, Tenth Avenue and Thirty-sixth Street, New York. For more than one copy a charge of 25 cents each is made to cover a portion of the postage, printing and compilation costs.

Program of Portland (Ore.) Central Station

Extensions and betterments in the properties of the Portland (Ore.) Railway, Light & Power Company during the coming year will mean the expenditure of $5,000,000, according to Franklin T. Griffith, president of the company, who has just returned from the East. Half of this amount will go into the new Oak Grove hydro-electric project on the Clackamas River, which will be completed by the summer of 1924. The waterwheel and generator have already been ordered for the first unit, which will develop 25,000 kw. The plant will have an ultimate capacity of 75,000 kw. and will cost about $10,000,000. The rest of next year's outlay will be expended in improvements that will keep the properties of the company thoroughly modern.

Political Status of Fight on Indiana Commission

It is doubtful whether the opponents of the Indiana Public Service Commission who for six months have been endeavoring to crystallize opinion in favor of its abolition will get far in the coming session of the Legislature. The Democratic members of that body, who will form a strong minority, had been counted on by the foes of the commission to favor doing away with state regulation, but they are likely, as foreshadowed by the result of a caucus, to content themselves with advocating "home rule" and to favor leaving the commission in control over utilities which are more than local in their scope. There will be a determined fight by the utilities all over the state against any such change in the law.

Philadelphia Electric to Pay Wage Dividend

A "wage dividend" for 1922 has been declared by the Philadelphia Electric Company, according to an announcement by Joseph B. McCall, the president. Payments under this plan will be made from the earnings of the system over and above fixed charges, dividends of 8 per cent on preferred and not less than 8 per cent on common stock and proper credits to surplus account. Employees through the calendar year 1922 will receive 2 per cent on their pay for that year, employees through 1921 and 1922 will receive 4 per cent, employees of three and four years' standing will be paid 6 per cent, and employees for five years or more previous to Dec. 31, 1922, will have 8 per cent. The plan is for this year only, but may be continued from year to year, at the discretion of the directors.

Oklahoma Utilities Increasing Capacity 146 per Cent

Construction plans for 1923 for the Standard Gas & Electric Company's subsidiaries in Oklahoma will increase their present capacity from 34,102 hp. to 84,102 hp., a gain of 146 per cent. The Muskogee plant of the Oklahoma General Power Company, originally planned for 10,000 hp., will be increased to 30,000 hp., while the Oklahoma Gas & Electric Company will construct another steam plant with a capacity of 20,000 hp. near Harrah, about 20 miles from Oklahoma City. Both of these

plants will be erected by the Byllesby Engineering & Management Corporation. The plant at Muskogee is planned for the use of either coal or fuel oil, while the Harrah station will be able to use coal, oil or gas.

This increased capacity will directly benefit the forty-two communities now served, since, as previously announced, plans have been recently made for the construction of a 60-mile high-tension transmission line to connect the system of the Oklahoma Gas & Electric Company with that of the Fort Smith Light & Traction Company. The first named company also serves eleven communities in Arkansas through the Mississippi Valley Power Company, which was recently organized to acquire and operate approximately 60 miles of high-tension lines in that state. Of the forty-two towns served by the Oklahoma Gas & Electric Company, fifteen were added to the transmission system in 1922, and nine of these abandoned municipally operated electric plants in favor of central-station service. The total number of electric service customers in 1918 was 27,730. In August last this figure had risen to 44,850.

Design Features of Cahokia Station

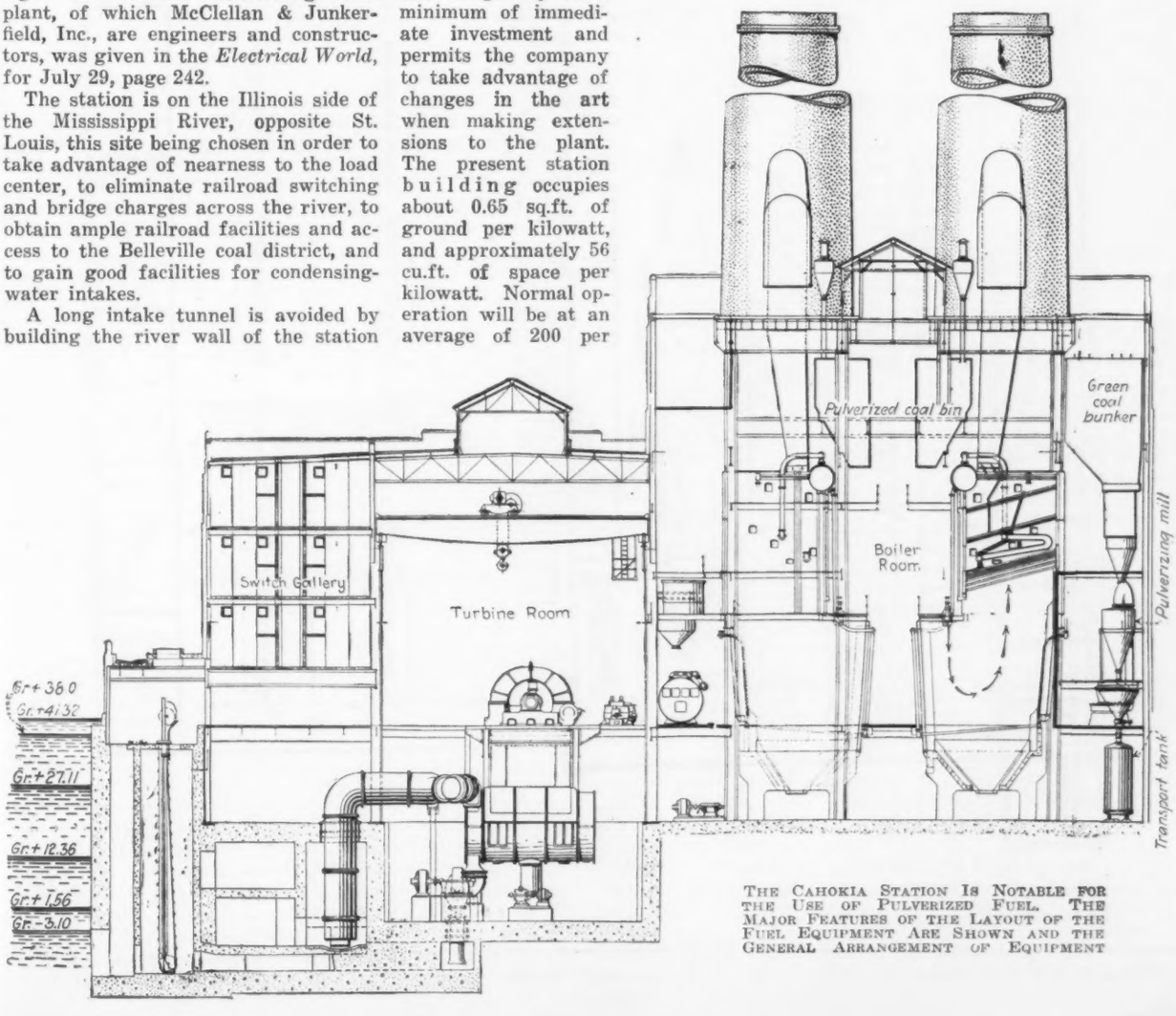
Intake Tunnels, Condensing Equipment, Coal-Handling and Pulverizing System, Phase Arrangement, Control Rooms and Other Points of New St. Louis Power House

CENTRAL-STATION engineers are watching with interest the developments in the design of the new Cahokia plant of the Union Electric Light & Power Company in St. Louis, because it will incorporate interesting features in the use of pulverized fuel and will represent late developments in station design. Information concerning this plant, of which McClellan & Junkerfield, Inc., are engineers and constructors, was given in the *Electrical World*, for July 29, page 242.

The station is on the Illinois side of the Mississippi River, opposite St. Louis, this site being chosen in order to take advantage of nearness to the load center, to eliminate railroad switching and bridge charges across the river, to obtain ample railroad facilities and access to the Belleville coal district, and to gain good facilities for condensing-water intakes.

A long intake tunnel is avoided by building the river wall of the station on the inner harbor line, the tunnels not projecting outside the building. The ultimate station is to contain four unit sections, each containing two turbo-generator units. At present there are being installed two 30,000-kw. turbines, supplied by eight boilers, each with 18,000 sq.ft. of heating space. The unit design requires a minimum of immediate investment and permits the company to take advantage of changes in the art when making extensions to the plant. The present station building occupies about 0.65 sq.ft. of ground per kilowatt, and approximately 56 cu.ft. of space per kilowatt. Normal operation will be at an average of 200 per cent rating and for short peaks at 300 per cent rating. The steam pressure will be 300 lb. with 250 deg. superheat at the throttle. A distinct feature is the inclusion of all the preparation plant for the pulverized fuel within the walls of the boiler room. The pulverizing rooms are isolated from the plant proper by concrete partition walls and floors and are so arranged that the windows on the outer walls will relieve the pressure in the remote contingency of an explosion.

The site is a few hundred feet south of the south limits of East St. Louis, between the government levee and the river, and consists of about 50 acres of low, flat river-bottom ground, which at time of high water last spring was entirely flooded. It was therefore necessary to provide additional levees on the site to connect with the existing levee and with the high railroad embankments, in order to construct the plant. The difference between extreme high and extreme low water is nearly 45 ft. The condensing equipment is placed in an elliptical pit whose floor is 42 ft. below the turbine platform. The entire station is supported on concrete piles. The river wall on the inner harbor line, which is also the west wall



THE CAHOKIA STATION IS NOTABLE FOR THE USE OF PULVERIZED FUEL. THE MAJOR FEATURES OF THE LAYOUT OF THE FUEL EQUIPMENT ARE SHOWN AND THE GENERAL ARRANGEMENT OF EQUIPMENT

of station, consists of interlocked concrete sheet piles, about 75 ft. long and weighing 15 tons each. The turbine room, electrical bay and river bay are supported on pre-cast concrete piles and the boiler room on standard Raymond concrete piles. On the north and east this site is bounded by hundreds of acres of railroad yards.

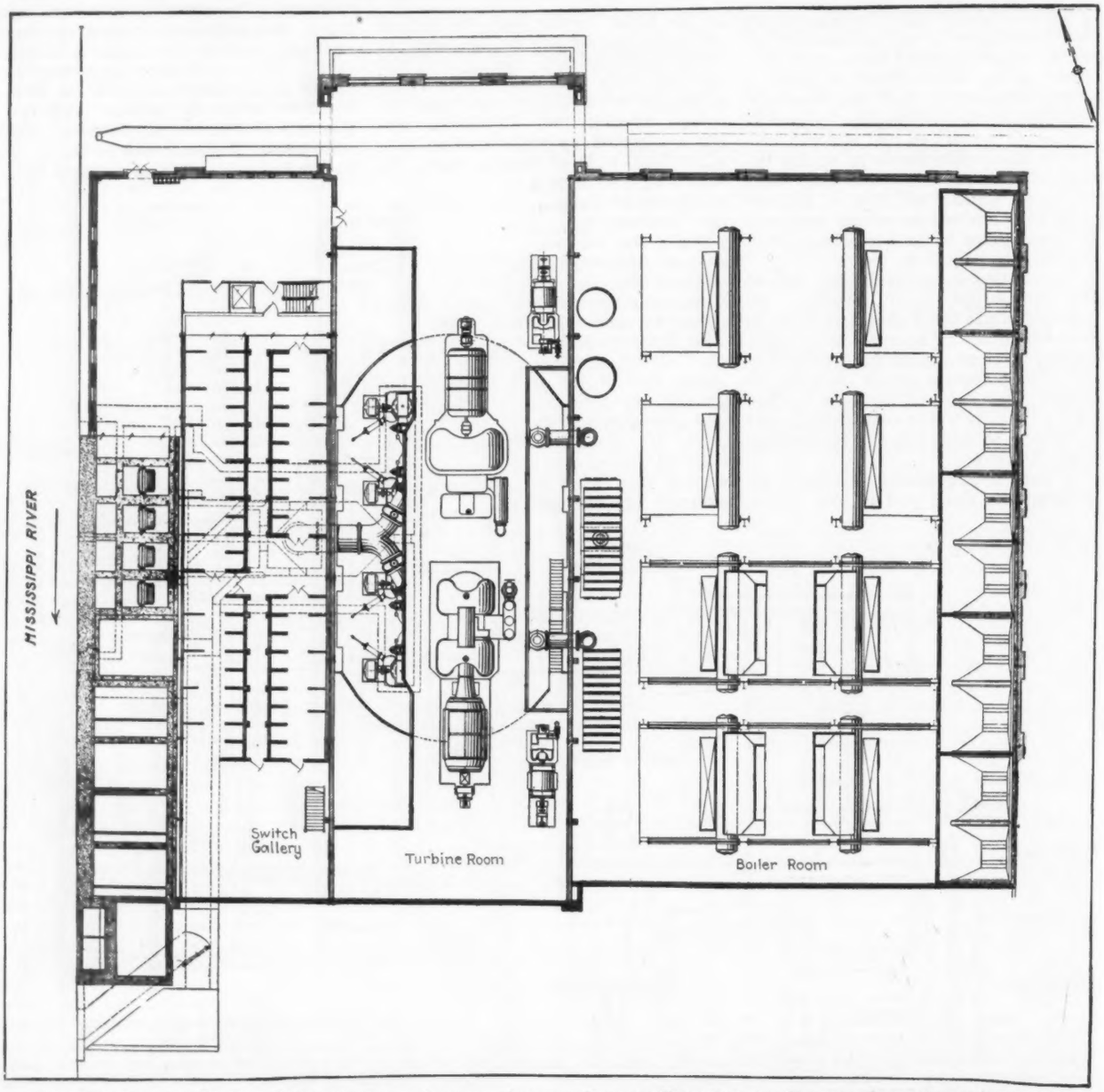
COAL-HANDLING SYSTEM

The incoming coal in railroad cars passes over track scales to a car dumper of sufficient capacity for the ultimate plant. From the dumper the coal goes over belts to a Bradford breaker of sufficient capacity to supply one-half the ultimate station. From the breaker the coal passes on belts to two vertical conveyors of the same total capacity as the breaker, and thence on another belt conveyor of half this capacity to the raw-coal bunkers for the first section, or one-quarter of the ultimate plant. The raw coal from the overhead bunkers is delivered by gravity through a stationary dryer to the pulverizing mills. From the mills it passes to small pulverized-fuel hoppers and thence to a Quigley transport system, including a 4-ton blowing and weighing tank for each mill. From each tank the fuel goes by means of a 4-in. pipe to the bunkers, one of which is installed in front of and above each boiler. These coal bunkers have a total capacity of 75 tons each.

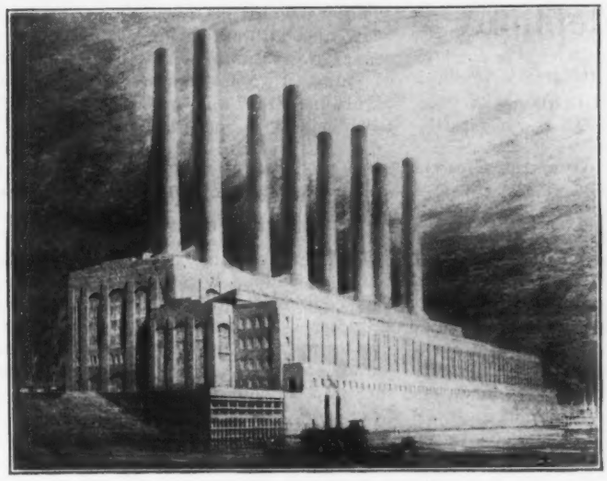
There are eight pulverized-coal mills for the eight boilers, which when operating sixteen hours per day will pulverize the coal needed for twenty-four hours of boiler operation. In addition, there are two spare mills installed as a reserve. Natural draft will be used in the plant and no economizers will be installed, although space is available should fuel prices warrant their installation at a later date.

Energy will be generated at 13,800 volts, three-phase, 60 cycles, and transmitted at this voltage and at 33,000 volts through step-up transformers. All the units and feeders are connected to a 13,800-volt bus, with sectionalized main ring, and in addition there is a reserve bus. Ultimately an outdoor substation may be used with 66,000-volt outgoing lines. Adjoining sections of the low-tension main bus are connected through reactors. A sectionalized scheme is used without reactors for the reserve bus. Each bus section consists of one main unit and a group of feeders.

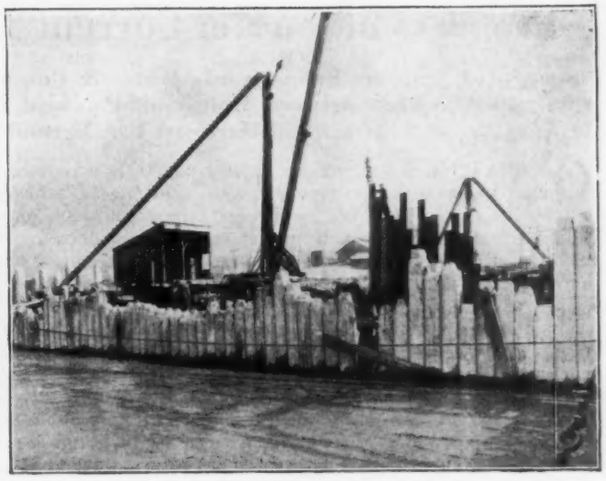
A vertical isolated phase arrangement for buses and circuit breakers will be installed, employing a separate floor for each phase. The main and reserve buses of the same phase are on



PLAN VIEW OF THE PRESENT CONSTRUCTION AT CAHOKIA, SHOWING GENERAL FEATURES AND RELATIVE LOCATION OF APPARATUS



VIEW OF ULTIMATE PLANT FROM RIVER



A CONCRETE RIVER-RETAINING WALL

one floor in separate rooms with an operating aisle between. A truck-type circuit breaker is to be suspended from the side walls of the breaker compartment, containing the single-pole element for each phase. The large oil circuit breakers are operated by vertical rods from the floor below the lowest phase floor. Disconnecting switches will be remote, manually operated and mechanically interlocked with the oil circuit breakers.

CONTROL ROOMS

There will be a main generator and feeder control room on the level of the lowest phase floor of the switch house near the temporary end of the station. This level is about 12 ft. above the turbo-generator platform. Another room for the heat-balance control will be directly under the main switchboard control room on a level with the turbo-generator platform. From this room remote control of some of the auxiliaries is available, such as of the speed and throttle of house turbines and certain motor-driven pumps. The control will permit stopping of the auxiliaries but not starting them.

The boiler-room control will be under the direction of a boiler-watch engineer with the control for each four boilers near the individual boilers in this group. Control of the fuel feeders to the burners is obtained by direct-current motors, with a supply obtained through the use of duplicate motor-generator sets.

Nearly all auxiliaries are electrically operated and with few exceptions are constant-speed equipment.

The station is built for bulk power purposes and will have three direct tie lines to the present Ashley Street station and other 33,000-volt and 13,800-volt lines to existing and new substations. Outgoing lines are protected with overload relays and sheath transformers. The step-up transformers are installed on a platform outside the switchhouse. Feeders will leave the station partly in underground ducts and partly as submarine cables crossing the river.

The new station is expected to be in operation next fall to carry load in excess of that derived from Keokuk water power and the present Ashley Street steam station.

More Ontario Hydro Losses

Deficit of Over $200,000 Indicated on Central System, Which Was Acquired in 1916

A REPORT issued by the government board of inquiry which, under the direction of W. D. Gregory of Toronto, is looking into the operations of the Hydro-Electric Power Commission of Ontario shows that there have been continuous losses on the Central Ontario System, which was acquired by the province from the Electric Power Company in April, 1916, for $8,350,000 and for which ten-year 4 per cent bonds were issued. The system comprises two main sections, one supplying electrical energy to certain municipalities, private companies and others in central Ontario, the other generating and transmitting energy in the municipalities of North Bay, Callender, Powassan and Nipissing, much further north. In the first of these sections gas works, waterworks, a pulp mill and pulp lands and the Peterboro Radial Railway are included.

MANY LOSSES SHOWN

According to the accountants employed by the board of inquiry, or royal commission, the estimated operating deficit on the system for the year ended October, 1922, was $38,200, and for the whole period of Hydro ownership the total net losses are given as $207,168. Municipalities where there has been a profit are demanding that they be allowed to take over the local plants instead of having the surplus receipts applied to cover up shortages in other places. If this were done, the province would have to stand losses represented by sums paid for intangibles when the system was acquired. These intangibles, representing good will, potential water power and similar things, amounted to $2,677,342, and the investigating accountants see no way by which the province could be reimbursed for this sum or any part of it were the plants turned over to the municipalities.

On the Peterboro Radial Railway there has been a total net loss of $119,708, on gas works in various towns a loss of $104,674, and on contracts for the supply of electric light and power to various municipalities and private companies a loss of about $169,000 in three years. The evidence shows that the losses on the system are not merely under contracts which the Hydro-Electric Commission took over, but on business done by the commission itself after it acquired the system. The facts as presented show a state of affairs not very much better than that on the Nipigon division made public some time ago.

Hoover Advocates Fewer Government Agencies

Reorganization of the government agencies dealing with commerce, mining, manufacturing, shipping, fisheries and transportation facilities into three groups, each under an assistant secretary, was recommended by Secretary of Commerce Hoover in his annual report to Congress.

Whether these groups, which would concern themselves respectively with industry, trade and navigation, should be brought into the Commerce Department, he declared, was secondary to the necessity for the grouping itself, in order to obtain concentration of purpose to eliminate overlapping. A direct saving of upward of $1,000,000 a year in administration would be possible under the plan, he estimated, while many times that amount would be given to the public in increased values and services.

Administration of these functions, Mr. Hoover explained, now is divided among seven different departments of widely different major purposes, with the result that there is "inevitable overlap, duplication and lack of purpose."

Progress in Carrier-Current Telephony

Successful Tests by Pennsylvania Water & Power Company Over 40-Mile Line Between Holtwood, Pa., and Baltimore—Utica and Hartford Use Method

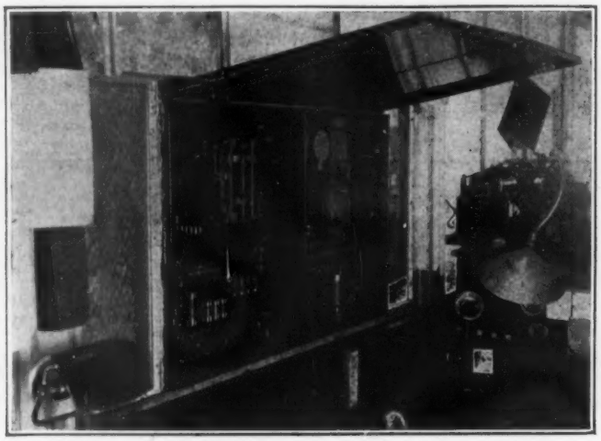
OPERATING tests of a carrier-current system of telephone communication were held Wednesday and Thursday of this week in Baltimore by the Pennsylvania Water & Power Company, which has installed the system on its 40-mile, 70,000-volt, three-phase transmission line between the Holtwood (Pa.) hydro-electric generating station and a substation in Baltimore. Communication under varying conditions was effected in both directions. The Pennsylvania Water & Power Company is among the first three companies to adopt carrier current for commercial operations. The system was installed first by the Utica (N. Y.) Gas & Electric Company, and it has also been put in operation recently by the Hartford (Conn.) Electric Light Company. The tests at Baltimore were made under the direction of F. A. Allner, chief engineer of the operating company, in conjunction with engineers of the General Electric Company who installed the system. Mr. Allner is chairman of the radio committee of the National Electric Light Association.

A 220-volt storage battery is used to operate a motor-generator developing 1,000 volts direct current. This is then passed through a 50-watt pliotron oscillating tube which gives about 5,000 volts alternating current at 15,000 cycles. This current is then transferred to the transmission line through a capacity coupler. A second 50-watt tube used as a modulator is then employed to superimpose the voice on the higher-frequency current, and the voice frequency is thus carried along with the carrier current. Reception is effected by apparatus similar to that used in ordinary radio, employing a detector tube and two stages of audio-frequency amplification. It is possible also to ring a signal bell before beginning conversation.

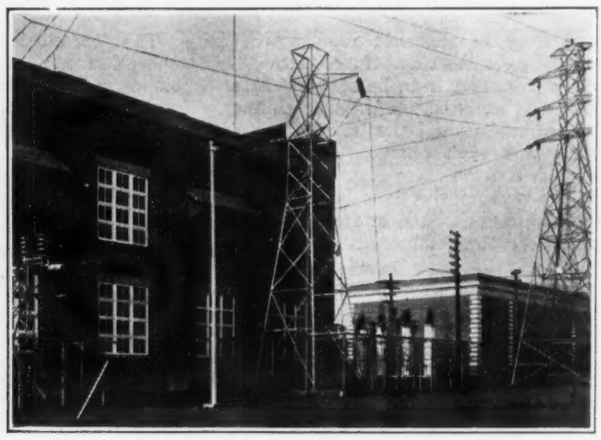
Mr. Allner, in commenting on the tests to a representative of the *Electrical World*, said he believed the carrier-current telephone system should prove of immediate interest and usefulness to central stations confronted with communication problems, especially those operating remote generating stations in connection with overhead long-distance high-voltage transmission lines. The decision of the Pennsylvania company to install carrier current dated back to trouble encountered in 1921 as the result of a severe electrical storm, Mr. Allner said. "Our tests," he continued, "are intended to show how well the carrier-current system meets a variety of actual conditions as nearly as we can produce them."

Among the tests made was to effect communication with an arcing ground between the high-tension line and ground, while grounding all the high-tension lines at one or more points and while short-circuiting two phases of the line, thus throwing the phases out of balance and creating heavy ground currents.

In addition to the three companies mentioned, the General Electric Company is installing similar systems for ten other central stations on lines carrying up to 220,000 volts.



TRANSMITTING AND RECEIVING EQUIPMENT FOR INTERSTATION CARRIER-CURRENT TELEPHONE SYSTEM



TRANSMISSION LINE TO WHICH THE CARRIER-CURRENT EQUIPMENT WAS CAPACITATIVELY COUPLED

Northern States Power Is to Build 100,000-Hp. Plant

The Northern States Power Company announced on Wednesday that the construction of a five-million-dollar steam-turbine power plant in St. Paul, to generate 100,000 hp., will start next week. This plant is to be the first step in an eighty-million-dollar program hailed as the greatest electrical development yet projected in the Middle Northwest. Plans include the St. Croix River development and others with a total potential output of 200,000 hp.

The St. Paul Gas Light Company last week filed an application with the Federal Power Commission for a license to build a 20,000-hp. electric power plant in St. Paul on a Mississippi River island, to cost $1,500,000.

Engineering Graduates in Commercial Work

That engineering college graduates are handicapped without a supplementary commercial training is the conclusion based on research investigations just completed by Dr. W. F. Rittman and W. F. Reilly of the Carnegie Institute of Technology, Pittsburgh. In the *Carnegie Technical Journal*, a quarterly publication of the alumni and students of the institution, Messrs. Rittman and Reilly present what they hold to be substantial proof of the need of commercial training in technological college courses.

With the co-operation of the alumni office a study of the present occupations of Carnegie graduates was made. Of the engineering graduates from 1908 to 1921, the investigations showed that approximately 67 per cent are now engaged in commercial or managerial work. These graduates include those from highly technical fields, such as mechanical, electrical, civil, chemical, metallurgical, mining and sanitary engineering and science.

An interesting tabulation in the report shows the following percentages of engineering graduates in all departments who are now in commercial or managerial capacities: Mechanical engineering, 65; electrical engineering, 60; civil engineering, 73; chemical engineering, 59; commercial engineering, 91; metallurgical and mining engineering, 67; sanitary engineering, 60; science, 77. The authors say that "the great majority of graduates use their technical education as a means of getting into commercial or managerial work."

The Carnegie Institute of Technology was one of the first technical institutions to incorporate a separate commercial engineering course in its College of Engineering.

Ford After High Dam

Detroit Manufacturer Files a Direct Application for Power from Mississippi at St. Paul

IF THE Minnesota Legislature does not take action involving the use of the High Dam built by the federal government in the Mississippi River between St. Paul and Minneapolis, the Federal Power Commission is expected to act quickly in the matter. The conflict over who shall utilize the power which can be developed there has already cost the United States government nearly $700,000. The matter has been further complicated by the filing of an application by Henry Ford.

The trouble began when the St. Paul Association induced the city of St. Paul to file an application with the Federal Power Commission for the right to develop the power which could be produced at the dam. The St. Paul Association is endeavoring to establish a new industrial area and as a part of that campaign had obtained the promise of Henry Ford to build a factory to employ 5,000 men on the understanding that the association would obtain power rights which it would transfer to him.

This action caused the Northern States Power Company to file a conflicting application. Still another conflicting application was filed by the city of Minneapolis. The Federal Power Commission held a hearing, but a decision was delayed so as to give the Municipal Electric Corporation, composed of the cities of St. Paul and Minneapolis and the University of Minnesota, an opportunity to obtain the necessary state legislation to construct and operate the power plant.

Twin Cities at Odds

It is thought by those who have observed the situation closely that there is no chance for the two cities to get together on any proposition. In the meantime it has become apparent that the Power Commission will hardly grant a license for such an indirect arrangement as is involved in the St. Paul-Henry Ford scheme.

One of Mr. Ford's policies is not to make a contract with a public utility corporation, because he contends that a commission at any time can break his contract. Otherwise the logical way to handle the matter would be to grant a license to the Northern States Power Company, whose large generating and distribution system would make possible the utilization of all of the secondary power. So far as the federal government is concerned, an equally satisfactory solution would be to grant a license to Mr. Ford, with the requirement that he install equipment so as to make full use of the secondary power and that he sell his surplus to public utility corporations. This arrangement would be satisfactory to all concerned, it is believed, except the city of Minneapolis, which feels that it has a half interest in the power rights and that by such an arrangement St. Paul would be getting more than its share. The Minneapolis interests claim that a real-estate scheme really is the foundation of the plan put forward by the St. Paul association. This the St. Paul interests deny.

Prospects Favorable for Ozark Utilities

Power developments in the Ozark territory will receive another impetus when the 60,000-hp. dam is completed on the White River at Table Rock. A permit for this development has been issued by the Federal Power Commission to the Empire District Electric Company, Joplin, Mo., an H. L. Doherty property. This 175-ft. dam, which will cost $15,000,000, will create a reservoir about 63 miles long with a shore length of about 500 miles. It will back up the White River to Beaver, Ark., and the James River to a point near Galena, forming two lakes approximately 80 miles in length. The company is also laying plans to erect two other dams, one near Moore's Ferry and the other at Horseshoe Bend, below Forsyth, on the White River.

Tennessee Has Its First Utility Conference

The establishment of good public relations, the significance and importance of regulation by utility commissions and the value to the utility industry of the Tennessee Public Service Information Bureau were the principal themes of the first public utility conference held in Tennessee, when more than a hundred operators met at the State University in Knoxville on Dec. 14.

The session was called by Percy Warner, chairman of the Tennessee Public Service Association. One of the principal addresses of the day was that by Julian H. Campbell, chairman of the Tennessee Railroad and Public Utilities Commission. In speaking on the public's interest in the commission he told the utility men that the orders of the regulative body must inspire the confidence of the public and still provide an incentive to the utility.

Another address of importance was made by Lovick P. Miles of Memphis, general counsel for the Memphis Power & Light Company, who related the history of regulating utilities, saying that the plan for a state tribunal with complete jurisdiction is now generally regarded as the best means to compel the utilities and the public to discharge their obligations.

Speaking on "How the Public Utility in the Small Town Can Aid in Building Up the Community," W. S. Harkness of Jellico urged such operators to enlist the support and activity of the mischievous boys of the town.

Other speakers were President H. A. Morgan of the University of Tennessee and Ross Murphy, director of the Tennessee Public Service Information Bureau. Judge H. B. Lindsay presided at the luncheon where part of the program was given.

The Utility and the Public

President Smith Dwells Upon Their Relations and Champions Customer Ownership

FRANK W. SMITH, president of the National Electric Light Association and vice-president of the United Electric Light & Power Company, New York, addressed the Rotary Club at Newburgh, N. Y., recently on "What Does the Public Utility Mean to the Public?"

Quoting Martin J. Insull's definition of a public utility as "a business affected with a public interest," Mr. Smith said: "This public interest is, of course, by no means one-sided, for as the success of the public depends on the success of the utilities, it is also true that these utilities, which are in every sense of the word public servants, depend to a opinion.

"There is now invested in the business in the United States more than five billion dollars. The business has a gross income of more than nine hundred million dollars. It employs directly a force of nearly two hundred thousand men and women, and indirectly it is estimated that it employs more than two hundred and fifty thousand other workers. The industry has harnessed falling waters and made their energy available to the extent of about eight million horsepower, and the capacity of the stations operated by steam, both large and small, is in excess of fourteen million horsepower. It has been estimated that by 1930 the present generating capacity of the electric light and power companies will be doubled, or, in other words, in seven years' time the electric industry will be called upon to create as much as it has created so far during its entire existence of about forty years.

The Public the Real Owner

"Now, who are the real owners of this 'big business'? As a matter of fact, the people themselves. First, somewhere in the neighborhood of two million thrifty security holders have invested their savings with the light and power companies and the number is growing rapidly. The public has come to realize that this class of investment is safe and affords a fair rate of return, and the companies have come to realize on their side that their best interest lies in taking their customers and the public generally into partnership with the utilities as holders of their securities.

"Then we come to another class of owners—every person who carries a life insurance policy, because it must be remembered that the insurance companies themselves are heavy investors in securities of electric light and power companies. Three hundred millions of dollars are thus invested. Likewise every depositor in the national banks of the country is interested, directly or indirectly, in the success of the electric light and power business. And there are upward of twenty-seven millions of these depositors in the country."

Consolidations Under Way in Wisconsin

The Middle West Utilities Company, owner of the Eastern Wisconsin Electric Company properties in Oshkosh, Sheboygan and Fond du Lac, has acquired the entire holdings of the syndicate which late in 1921 obtained a controlling interest in the Ironwood & Bessemer Railway & Light Company, the Ashland Light, Power & Street Railway Company and the Big Falls Water Power Company. After the acquisition of control in the three companies the name of the Big Falls Water Power Company was changed to the Lake Superior District Power Company, and under that name they were merged a few months ago. By the transaction just consummated the Middle West Utilities Company, which was a participant in the syndicate, obtains for itself all of the common stock of the Lake Superior District Power Company, together with certain preferred holdings and other assets.

Acquisition by the Wisconsin Edison Company of Milwaukee of an interest in the Badger Public Service Company, which operates electric light and power lines in Sheboygan County and the eastern part of Fond du Lac County, has been announced by W. N. Albertson, president and general manager of the Badger Public Service Company. The Wisconsin Edison Company is a subsidiary of the North American Company of New York City, which controls the Milwaukee Electric Railway & Light Company and the Wisconsin Gas & Electric Company of Kenosha and Racine.

In addition to communities in Washington and Ozaukee Counties, the Badger Public Service Company serves districts around Elkhart Lake, Crystal Lake, Greenbush and Glenbeulah, in Sheboygan County, and St. Cloud, Calvary, Mount Calvary, Malone and Johnsburg, in Fond du Lac County.

The Badger Public Service Company is, as already stated in the *Electrical World*, involved with the Eastern Wisconsin Electric Company in a controversy over the right to extend lines into the town of Calumet. The State Railroad Commission recently gave this right to the Eastern Wisconsin Electric Company, but the Badger Public Service Company has appealed the decision to the circuit court in Madison.

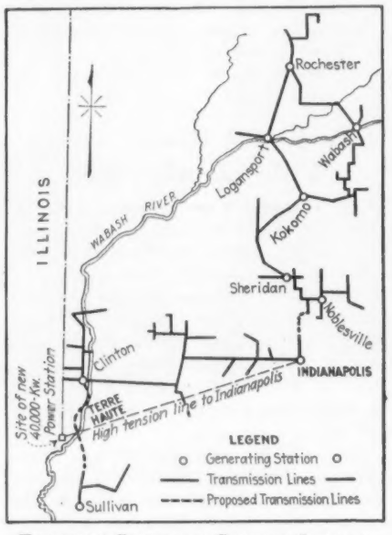
American Engineering Council to Meet Jan. 11

Meeting in Washington, D. C., on Jan. 11 and 12 for its annual conference, the American Engineering Council of the Federated American Engineering Societies will consider problems of national interest, including the report of the committee on work periods in continuous industries, which has declared in favor of the eight-hour day. Dean Mortimer E. Cooley of the University of Michigan, president of the federation, will preside.

On the evening of Friday, Jan. 12, a dinner, at which engineers from all parts of the country will be present, will be given in honor of Prince Gelasio Gaetani, the new Ambassador from Italy, who has recently arrived in this country. Prince Gaetani is himself a technical man and was formerly a resident of the United States, having graduated from the School of Mines of Columbia University in 1903 and practiced successfully in the art of ore dressing in the western part of the country.

Financing the Indiana Consolidations

The offer by Stone & Webster, Inc., and New York and Boston banking houses of $3,800,000 Central Indiana Power Company 7 per cent preferred stock is a step in the financing of that consolidation of electric power and



TERRITORY SERVED BY CENTRAL INDIANA POWER COMPANY SYSTEM

lighting utilities, which will serve about seventy cities and towns in Central Indiana, with Indianapolis as a center. These places are all to be interconnected and will depend in part on the new power station with an initial rating of 40,000 kw. to be built on the Wabash River in the center of 3,400 acres of coal lands which the company has acquired. The system will serve half a million people, and the total cost of the new station and the interconnections is put at $12,000,000. The power house will be built by Stone & Webster under the supervision of Kelsey, Brewer & Company of Grand Rapids, Mich., managers of the new system.

Authorization from the Indiana Public Service Commission has been granted to the Northern Indiana Power Company to purchase and consolidate the Indiana Railways & Light Company of Kokomo, the United Public Service Company of Rochester, the Noblesville Heat, Light & Power Company, the Sheridan Water, Light & Heat Company, the Wabash Water & Light Company, the Logansport Utilities Company and the Roann Light & Power Company. This consolidation was noted in the *Electrical World* for Dec. 2, page 1235. Its headquarters will be at Kokomo, and Joseph H. Brewer has been elected as its president. Stone & Webster, it is reported, have taken $5,000,000 of the Northern Indiana Power Company's securities.

Craft Favors Separation of Two Kinds of Research

"Leave the fundamental and scientific research work to the universities, but not the industrial research," said E. B. Craft, chief engineer of the Western Electric Company, in an address made at Montreal on Saturday, Dec. 16, to the Engineering Institute of Canada, at a largely attended meeting. "The universities are concerned with pure scientific research, and they should confine themselves to that, leaving industry, through its own specialized research, to solve its own industrial problems.

"Purely scientific research demands a different type of mind from that demanded by industrial research," Mr. Craft went on to say, "and it requires both experience and practical observation to find the latter type, although men more adapted for fundamental scientific research are turning to the industrial field because it offers more immediate results, both financially and in practical achievement. But the two must be kept separate if we are to get the best results and keep both pure science and scientific industrial research on this continent to the forefront."

Hydraulic Race Company Gets Revocable License

Action on the part of the Federal Power Commission authorizing a revocable license to the Hydraulic Race Company, involving a diversion of 500 cu.ft. per second of water through the State Barge Canal at Lockport, N. Y., has occasioned surprise. It was expected that some understanding would be reached with New York State officials before any action was taken. It is true that the Federal Power Commission had made ineffectual efforts to reach an agreement with the officials of New York State. A part of the delay at least can be charged to the test which the State of New York is making of the federal water-power act and to the coming change of administration in the state. It is believed, however, that the action of the Federal Power Commission will precipitate early action on the part of the New York State authorities.

An oral protest was made at a hearing at the offices of the commission on Dec. 19 by representatives of the Western New York Utilities Company. It was made plain that the New York officials are planning a power project at Lockport which would conflict very seriously with the project of the Hydraulic Race Company.

Brief News Notes

Eastern Connecticut Power Company Expands. — The Eastern Connecticut Power Company, Montville, Conn., has purchased the People's Light & Power Company and the affiliated Danielson & Plainfield Gas & Electric Company, furnishing electric light and power in the towns of Killingly, Danielson, Brooklyn, Plainfield, Canterbury, Griswold, Jewett City and other smaller towns and villages of eastern Connecticut.

Ohio Power Company Buys Lima Plant.—The Ohio Power Company of Newark, Ohio, has been authorized to purchase the electric lighting and steam-heating system formerly operated by the Ohio Electric Railway Company in the city of Lima. The sale price was $1,700,000. The property was recently sold by the receiver. The Ohio Power Company is to assume $1,250,000 underlying bonds and $200,000 in prior liens, besides paying $250,000 cash for the property.

Hartford Company Votes Stock Increase.—The Hartford (Conn.) Electric Light Company at a meeting held on Dec. 19 voted to increase the capital stock of the company from $10,000,000 to $12,000,000, and the directors were authorized to offer the new stock at the ratio of one share of new to five shares of old stock, at par. It was announced at the meeting that the 1922 energy sales of the company had been estimated at 130,000,000 kw.-hr., while the business of last year totaled 97,000,000 kw.-hr.

Fight Over Municipal Plant at Hagerstown, Md.—Mayor Charles E. Bowman and the City Council of Hagerstown, Md., desire to pass an ordinance authorizing a bond issue of $300,000 to build a new municipal electric light plant. The project is opposed by a number of citizens who claim that they can purchase energy from the Potomac Public Service Corporation cheaper than the city can supply it. The plan will probably be submitted to a vote of the people.

Irrigation Board Favors Retailing, Not Wholesaling Energy.—The directors of the Modesto-Turlock irrigation district in California are opposed to wholesaling electric power to any city or community that may be served when the district installs its transmission lines from the Don Pedro Dam hydroelectric plant, where 15,000 kw. will be developed in connection with an irrigation project. It is the purpose of the directors to retail the power generated at the plant and distributed by the transmission lines now under construction. The city of Turlock, Cal., has already been refused power at wholesale rates. A recent application of the district asks for a franchise from the Board of Supervisors of Merced County for the erection of a transmission line and distributing system in the county to enable the district to sell electricity outside of the corporate limits of towns in Merced County.

Illinois Utility to Buy Abbott Light Company.—The Central Illinois Public Service Company has applied to the State Commerce Commission for permission to buy the property of the Abbott Light & Power Company at Petersburg. The agreement provides for an issue of $200,000 in preferred stock and $200,000 in first and refunding mortgage gold bonds. The Abbott company has a station capacity of 800 kva. and serves Petersburg, Ashland, Mason City, Pleasant Plains, Tallula, Middleton and Greenview.

Wisconsin Hydro-Electric Company Gets Chetek Plant.—Keen rivalry which has existed between the Wisconsin-Minnesota Light & Power Company of Eau Claire and the Wisconsin Hydro-Electric Company of Apple River for the control of the Chetek Light & Power Company of Chetek has been brought to an end by the announcement of the Chetek Light & Power Company that it has sold its plant and lines to the Wisconsin Hydro-Electric Company. Possession of the plant will be given as soon as the new line connecting Chetek with the power line running about one and a half miles east of Dallas is completed. The new owners have two plants on the Apple River and one at Colfax.

Hydro-Electric Development on the Rio Grande.—A permit has been granted by the State Engineer of New Mexico to Daniel L. Evans and associates to develop a 15,000-hp. hydroelectric project at the mouth of White Rock Canyon, on the Rio Grande west of Santa Fé, N. M. The project will cost about $1,500,000 and must be completed within a reasonable length of time. According to information furnished by the State Engineer, the plant will be capable of supplying electrical energy for commercial use to Santa Fé, Las Vegas and Albuquerque, and there is a possibility of obtaining enough power to electrify the main line of the Santa Fé between Albuquerque and Las Vegas or at least over the Glorieta grade.

Improved Equipment for New York City Ferryboats.—The most modern developments in electric drive will be utilized on the municipal ferryboats now under construction for New York City, according to a statement from the General Electric Company. Each of these three boats will be propelled by an eight-stage condensing Curtis marine-type turbine, and will be equipped with one General Electric turbine-driven alternating-current generator. This generator will in turn drive two marine-type two-speed induction motors having double squirrel-cage rotors. The high-speed winding will deliver 2,100 shaft horsepower at 176 r.p.m., and the low-speed winding will deliver 100 shaft horsepower at approximately 122 r.p.m. The ship may be maneuvered either ahead or astern.

Associations and Societies

Western Society Forms Illuminating Section.—On Dec. 15 the Western Society of Engineers formed an illuminating engineering section with A. L. Arenberg as chairman and J. J. Kirk as vice-president.

Chicago Electric Club's New Officers.—On Dec. 12 the Electric Club of Chicago elected the following officers for the new year: President, Paul W. Koch; first vice-president, Earl W. Donoko; second vice-president, Henry Nixon; secretary, J. C. Hall; treasurer, V. R. Lanestrom.

Southwestern Division, N. E. L. A.—Officers and committeemen of this division are busy making arrangements for the four-day meeting of the committees of the section at New Orleans in conjunction with the executive committee of the national body on Jan. 16 to 19. Preparations will then be made for the annual convention of the division, to be held in Oklahoma City on March 14 to 16 next, following the meeting of the Oklahoma Utilities Association. Six hundred delegates are expected in March.

Coming Meetings of Electrical and Other Technical Societies

A complete directory of electrical associations is published in the *Electrical World* in the first issue of each volume. See July 1 issue for latest list.

Federated American Engineering Societies —Washington, Jan. 11-12.

National Council Lighting Fixture Manufacturers—Cleveland, Jan. 15-20. C. H. Hofrichter, 231 Gordon Square Bldg., Cleveland.

Lighting Fixture Dealers' Society of America—Cleveland, Jan. 15-20. J. L. Wolf, Electrical League, Hotel Statler, Cleveland.

Western Association of Electrical Inspectors —Chicago, Jan. 23-25. W. S. Boyd, 175 W. Jackson Blvd., Chicago.

Iowa Engineering Society—Des Moines, Jan. 23-26.

Wisconsin State Association of Electragists —Milwaukee, Jan. 24-26. H. M. Northrup, 23 Erie St., Milwaukee.

Association Municipal Electrical Utilities of Ontario—Toronto, Jan. 25-26. S. R. A. Clement, 190 University Ave., Toronto.

Electrical Supply Jobbers' Association—Central Division, Chicago, Feb. 13-14; Atlantic Division, New York, Feb. 14; executive committee, Atlantic City, Jan. 15-16. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Institute of Electrical Engineers —New York, Feb. 14-16. F. L. Hutchinson, 33 West 39th St., New York.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 19-21.

American Physical Society—New York, Feb. 24. D. C. Miller, Case School of Applied Science, Cleveland.

Oklahoma Utilities Association—Oklahoma City, March 12-14. O. D. Hall, 1106 First National Bank Bldg., Oklahoma City.

Southwestern Division, N. E. L. A.—Oklahoma City, March 14-16. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Illinois State Electric Association—Chicago, March 16-17. R. V. Prather, 305 Mine Workers' Bldg., Springfield, Ill.

Wisconsin Utilities Association—Milwaukee, March 22-23. John N. Cadby, 445 Washington Bldg., Madison.

American Electrochemical Society—New York, May 3-5.

National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.

Recent Court Decisions

Powers of Illinois Commission.—In Terminal Railroad Association of St. Louis vs. Public Utilities Commission it has been held by the Supreme Court of Illinois that an intervening petitioner in a hearing on the application of a railroad for increased freight rates was not deprived of the right to have his complaint of excessive charges heard by the commission because the complainant in the case withdrew its petition, nor does the fact that a rate charged is that recognized by the public utilities act prevent the commission from determining complaints of unreasonableness and discrimination. (136 N. E. 797.)*

Control Over Rates for Natural Gas Transported from Outside State Denied to Commissions.—In two recent cases (Central Trust Company of New York vs. Consumers' Light, Heat & Power Company and State of Missouri vs. Kansas Natural Gas Company) United States district courts, sitting in Kansas and Missouri respectively, have denied that the state utility commissions have any jurisdiction over the rates charged for gas brought into the state by pipe line from another commonwealth. The only body that can regulate rates charged by such companies exercising no franchise rights in the state where control is sought is the Interstate Commerce Commission. (282 Fed. 680 and 341.)

Injury to Employee in Forbidden Place Held Not Compensable.—Where a painter working at an electric power plant was killed by contact with electric current as he commenced his day's work, without reporting to his foreman as required by instructions, and mounted a ladder which he set in a dangerous place, where he had been forbidden to work, the accident was not one arising out of and in the course of employment within the workmen's compensation act, and the employer was not liable. This was the decision of the Supreme Court of Michigan in an action for damages brought by the widow of Louis Gacesa against the Consumers' Power Company. (190 N. W. 279.)

What Is a Reasonable Extension of Service?—According to a decision of the Supreme Court of Oklahoma, in Oklahoma Gas & Electric Company vs. State, an order of the Corporation Commission requiring a gas company to extend its mains and service pipes to meet the reasonable needs of a community within the corporate limits of the city in which the company is operating under a franchise cannot be deemed arbitrary, unreasonable or unconstitutional where it appears that the company had a full hearing before the commission, that it is the only one authorized to serve the community in question with gas, and that the rate of return upon the cost of the extension, though amounting initially to only about 4 per cent, will probably soon become ample because of the growth of said community, and where the record does not show that the extension will render the business of the company as a whole unprofitable or cause an additional burden upon the gas consumers as a whole by making necessary an increase in the rates. (209 Pac. 777.)

Company Liable for Death of Policeman Who Shook Cable to Restore Light.—In Anderson vs. San Angelo Water, Light & Power Company damages were sought for the death of a policeman who sought to restore an arc light which had gone out by shaking the cable to which the lamp was attached for raising or lowering. It was shown that this practice was usual with members of the police force and that it was carried on with the knowledge and tacit approval of the company. The man who was killed, however, grasped the cable above instead of below an insulating knob and, the insulator next the lamp being defective, received a shock which proved fatal. The company alleged contributory negligence, but the Court of Civil Appeals of Texas overruled the plea and sustained the verdict of the trial court. (244 S. W. 571.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Burden of Cost of Extensions on Company.—An electric utility, the New Jersey Board of Public Utility Commissioners has declared in a complaint brought by one Chapman against the Electric Company of New Jersey, must supply service to a person past whose premises a line has been extended, without requiring a contribution to the cost of building the line and without regard to whether this person reimburses another with whom it is alleged he had contracted to contribute to the cost of obtaining the extension. This is true, the commission held, notwithstanding the fact that in the absence of this extension, procured as a result of the contract, it might not have been the company's duty to extend such service.

Theoretical Going Value.—No allowance for hypothetical, non-existent going value should be considered, declared the Michigan Public Utilities Commission *in re* Michigan State Telephone Company. "When a plant is valued as a going concern and the cost of organizing the company, getting the money together to build it, engineering it, laying it out and constructing it, getting the business and putting it in operation are included, the prevailing practice of including therein a theoretical, non-existent element of going value is indefensible. . . . The capitalization of operating losses under the guise of going value is absurd. It may make a non-paying concern more valuable than a paying one."

California Commission Explains Its Functions.—In view of two recent decisions of the California Supreme Court, one sustaining and the other reversing the California Railroad Commission in setting aside preferential contracts, the court holding in the latter case that the company concerned was not a public utility and hence that the commission did not have power over its contracts, the commission has issued an explanatory statement of its powers and functions, from which the following extracts are taken: "The commission has power over contracts, irrespective of the time they were made, entered into between public utility corporations and consumers, in which certain consumers—usually large and sometimes interlocked interests—seek to secure favored treatment and preferential rates at the expense of the great body of users. . . . The state in creating the commission charged it with the duty of correcting these abuses. The courts in a consistent line of decisions long antedating the creation of commissions have declared null and void inequitable contracts made by public utilities to the advantage of those favored and to the disadvantage of the great body of consumers. The Supreme Court of this state in repeated decisions has upheld the commission in the establishment of fair and just rates when to do so contracts specifying other rates for certain individuals and groups had to be disregarded. If this power were not inherent in the state, public regulation never could have started, for the utilities could have forestalled its regulatory powers by making in perpetuity contracts with favored consumer interests. . . . If an individual or a company has not dedicated its service to public use, but supplies only a limited number of private consumers and does not hold itself out to serve the public, the courts and this commission recognize such contracts as private and do not exercise or seek to exercise any control over them. On the other hand, when any individual or company dedicates itself to a public service, holding itself out to serve all persons in a given area, it thereby becomes a public utility, its service attains a public utility status, and the superior regulatory powers of the state prevail over any private contracts which it has attempted to make. . . . It may be said, in conclusion, that the duty of the court ends when it applies the law to the facts of a given case. The duty of the commission only fairly begins at this point, for the people of this state have imposed upon the commission the duty not only of requiring a public utility to furnish adequate and satisfactory service, but also of fixing rates that will permit the utility to function and at the same time will be fair to the users and not out of harmony with the value of the service as determined by local conditions as well as by broader economic considerations."

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Robert Sibley Takes Up University Alumni Work

Robert Sibley, for several years editor and more recently editorial director of the *Journal of Electricity and Western Industry* and Pacific Coast editorial director of the *Electrical World* and *Electrical Merchandising*, has resigned these positions with the McGraw-Hill Company to become associated in an executive capacity with the alumni work of the University of California. Mr. Sibley's connection with the McGraw-Hill Company's electrical journals will not, however, be completely severed, as he will retain his connection with the *Journal of Electricity and Western Industry* as a consulting editor and will also act as Pacific Coast consultant to both the *Electrical World* and *Electrical Merchandising*.

Mr. Sibley's connection with and contributions to the electrical industry in the country west of the Rockies are too well known to those in the industry in that aggressive electrical community to require extended discussion. Taking up editorial work on the *Journal of Electricity and Western Industry* while he was still professor of electrical engineering in the University of California, he developed the *Journal* into a publication which has rendered noteworthy service in its field. In rejoining the University of California he leaves behind him an organization of men in the McGraw-Hill Company of California who will carry forward the standards and purposes which he and his associates have established during the last two years in the service of the three papers with which he has been connected.

Harold R. Miller has been transferred from the Keokuk Electric Company to the assistant engineering manager's office in the Boston office of the Stone & Webster organization.

E. B. Powell of Stone & Webster, Inc., who sailed on the Majestic on Oct. 28, with Major Frederick Pope, to make a general investigation of power plants in Europe, was taken seriously ill soon after his arrival in France and has been at the American Hospital in Neuilly. Recent cablegrams from the physician in charge of Mr. Powell indicate a slow but continued improvement in his condition.

F. H. Cothran, division engineer of the Southern Power Company, will take active charge of the engineering work on the 200,000-hp. hydro-electric development project which is to be financed by J. B. Duke of Charlotte and New York and Sir William Price, Canadian capitalist, in the Province of Quebec, Canada. Mr. Cothran has been in charge of the Southern Power Company's developments in North Carolina. W. S. Lee, chief engineer of the Southern Power Company, will also give much time to the Canadian project, dividing his time between Quebec and North Carolina.

Carl D. Jackson Leaves Wisconsin Commission

Carl D. Jackson, who has been a member of the Wisconsin Railroad Commission since 1915 and chairman since 1916, has resigned that post, to take effect Dec. 31. Mr. Jackson has announced that he will practice law in New York City, and among his future clients he has already numbered the National Electric Light Association and the American Gas Association, which have come to recognize Mr. Jackson's fund of knowledge and ability in public utility affairs.

One of the outstanding features of Mr. Jackson's service as a commissioner was his activity in the National Association of Railway and Utilities Commissioners, where he was successively second vice-president, first vice-president and president, his presidential term having expired last month. He has always been active in constructive committee work in that organization, and the leadership of the Wisconsin commission in railroad and public utility regulation is due in no small part to his work.

Mr. Jackson was born in Evanston, Ill., in 1870 and graduated from Harvard in 1894. He practiced law continuously in Wisconsin from 1894 until his appointment to the commission in 1915.

Edgar Rypinski has been appointed manager of the Canadian plant of C. Brandes, Inc., which is known as Brandes, Ltd.

Obituary

F. J. Baker's Death Removes Another Utility Leader

Frank J. Baker, vice-president of the Public Service Company of Northern Illinois, Chicago, died suddenly of heart failure on Dec. 18 at his home in Wilmette, Ill. Mr. Baker was born in

F. J. BAKER

Cleveland in 1864 and was educated at the University of Michigan, where he took the degree of bachelor of science in 1887. Later he studied at the Northwestern University Law School in Chicago, obtaining the degree of bachelor of laws in 1897. In 1902, in association with Samuel Insull, Mr. Baker was active in the formation of the North Shore Electric Company, of which he served as vice-president from 1902 to 1911. In that year the Public Service Company of Northern Illinois was incorporated, being a consolidation of the North Shore Electric Company and a number of other public utility companies operating in the northeastern part of the state. From the organization of the company until the time of his death Mr. Baker was vice-president in charge of the operation, construction, purchasing, stores, claim and right-of-way departments. He was a member of the National Electric Light Association, American Institute of Electrical Engineers and Western Society of Engineers.

Warren A. Myers, prominent manufacturer, banker and former newspaper publisher, died on Christmas morning of heart disease after an illness of two years. Mr. Myers was secretary-treasurer of the Robbins & Myers Company Springfield, Ohio, manufacturer of electrical equipment, and was always active in civic movements. He was publisher of the Springfield *Sun* for a number of years. Mr. Myers was thirty-seven years of age.

Fred A. Marsh, general purchasing agent of the Link-Belt Company, died at his home in Chicago on Dec. 11 at the age of fifty-two. Mr. Marsh had been a member of the Link-Belt organization for over thirty-three years. He was one of the organizers of the Purchasing Agents' Association of Chicago and served as the first president, and had been a director in the National Association of Purchasing Agents.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

The Way to Increase Jobbers' Profits

How the Electrical Man Can Group His Specialties and Staples and Widen His Profit Margin—Getting Hints from the Grocer—Some Good Examples

By Claude L. Matthews

Vice-President and Secretary W. N. Matthews & Brother, Inc., St. Louis

A GREAT many men who sell electrical materials nowadays are complaining of lack of profit. They say that there is not enough money in electrical goods at ruling prices and with the large amount of competition which both the manufacturer and the distributor encounter at the present time. They say that something ought to be done about it. I agree with them. They are right. But in my opinion the thing that must be done is something that they have got to do themselves, and it is a very simple thing at that. In a word, the electrical industry has reached a point where its staple products are easy to sell and small in profit, and its specialties, which require hard work to sell, are about the only lines that offer large profits. Therefore, in order to net a satisfactory degree of profit on his sales, a distributor must contrive to sell enough specialties with his staples so that the average of his profits will hold a level somewhere between staples and specialties.

Specialties are usually really improved staples, providing a new way to do a piece of work or perform a service. The price set on these specialties must reward the manufacturer for his work of development, must give some extra compensation to the distributor for additional work in creating a market and must provide a saving to the user. When making, handling and buying reliable specialties, each branch of the industry gets its reward in proportion with the greater service value involved.

Group Them Like the Grocer

All this is natural and right and common to other established industries. Stand a while in a grocery store and see what happens. People come in to buy sugar, flour, bread, canned tomatoes, prunes and coffee. These are self-selling staples and the profit margin is very low. Therefore the grocer wastes no display space

C. L. MATTHEWS

upon them, but on his shelves and counters and in his windows and showcases he features marmalade, fancy crackers, special cheeses, nuts, canned fish and fancy candles, and these are what he sells. He takes orders for the staples; he talks about the specialties and points them out and recommends them. That is where he concentrates his selling, and that is where he makes his profits in the grocery business. And the same is true in other lines, in other trades.

Now, there is no reason why the electrical jobber and the electrical retailer should expect anything else. We are so young in this industry, and all our goods have been specialties so recently, that we are not yet entirely reconciled to handling a larger line in which the volume of the business is in staples that give little profit and the bulk of the opportunity for profit lies in the creative selling of specialties that must be sold by main strength, ingenuity and applied imagination. But, nevertheless, we are facing this very situation, and distributors of electrical materials must recognize it and begin to plan their selling so that they may group their staples and their specialties and sell them together. They must make their low-profit self-selling lines carry the higher-profit specialties by associating with the staples other lines that the customer uses with them and putting the selling pressure on these selected specialties whenever an order for the staple is in process. But the average distributor is not doing this extensively today.

Some Good Examples

I know one case of a small jobber who set up in business in a city with small capital. He knew that he could not afford to spend much time on low-profit staples. He decided to leave the staple lines temporarily to the bigger established jobbers there and devote himself to specialties. He knew that the salesmen of these other houses were not bothering much to push the specialties because they could pick up orders on staple lines more easily. So he just followed them around and sold the high-profit specialties that can be used with wire and conduit and the rest of the big-volume lines that they were selling. He got rich on it and now can sell the staples too.

I sat beside a jobber's desk the other day when the telephone rang and he took an order from a light and power company for some cable—a good-sized shipment. I asked him how much he made on it. He answered, "Two per cent." I said, "Why didn't you suggest that as they use that cable they will need various fittings? You could have sold them clamps for dead-ending and for turning corners, for one thing, and made more profit than you will on the cable itself, and yet you never said a word about it." He had simply taken an order and he

hadn't tried to sell a thing. And yet I know another jobber who the other day sold two carloads of cable and 300 cable clamps, and he made more on the clamps than on the wire.

Just as it is possible to sell cable and clamps together and raise the rate of profit on the sale, it is as easy and as profitable to group other staples and specialties that are associated as the customer uses them. When a man sells such staples as poles, cross-arms, glass insulators and the simple pole-line hardware devices, he can also sell specialties such as fuse switches, slack pullers, guy anchors and guy clamps and in many cases save the consumer big money in labor, which the distributor makes no profit on. When he sells "Mazda" lamps he can group with them portable guards, lamp guards, lamp changers, fixtures and glassware for commercial, industrial, showcase and window illumination and floodlighting. When he sells large appliances, like washing machines, vacuum cleaners, ironers, sewing machines, ranges or dishwashers, he can group with them smaller table appliances, flatirons, small radiators, curling irons and so on. When he sells sockets, conduit and wire, he can tie in with them complete lighting fixtures and lamp and glassware units or motors and automatic control switches, according to whether the stuff will be used on light or on power installations. In each case you combine the sale of a low-profit staple with the sale of some better-paying specialty that can be used with it by your customer.

This has been brought forcibly to mind in many cases where the orders apparently have been placed by the buyer for staples by direct shipment. If the salesman on the job had given his customer and his house the proper thought and service, there is no question that he would have received a further order for specialties which would have bolstered up the gross volume of profit on the entire purchase.

WHAT THE MANUFACTURER CAN DO

This is more than a bright idea, or just a scheme for selling. It involves a principle of distributing and marketing goods that is well established in other fields but has not been recognized and applied extensively by the electrical jobber. It is, therefore, also something more than good advice to the distributor. It is a matter which manufacturers of electrical goods should take no less an interest in and advocate and promote in every way possible. A very large electrical distributor is consistently and systematically trying to sell pole-line materials grouped this way. It would pay us all if other jobbers and manufacturers too would get behind the same idea and both in their advertising and their selling show the jobber how to group his lines with others and why he should.

It would pay the manufacturer of staples because the jobber would find a way to get more money out of staples by using them to help sell specialties. The jobber would then quit complaining about these low-profit lines, and the manufacturer would certainly welcome the cessation of complaints. It would help the manufacturer of specialties because more of his goods would be marketed. It would certainly help the disributor because he would begin to realize a greater margin of profit on his volume of sales. And undoubtedly it would raise the standard of construction and increase the sale of energy-consuming devices and accessories.

As long as the jobber is content merely to catalog goods and then wait for orders, just so long will his orders be mainly for staple goods that are very competitive in price and small in profit, and his sales of the big-profit specialties will also be small. Under these conditions he will continue to feel that he is underpaid for the work he does, and he will be right. But if he is willing to borrow a leaf from the salesbook of the grocer or the department-store man and introduce a reform in his method of selling, he can group his staples and his specialties together, strike an average between their wide and narrow profit margins and make some money.

Foreign Market for Steel Poles

Extension of Credit and Establishment of Confidence Are the Main Factors in Developing It—Transmission Lines Erected in Other Countries Are Well Built

BY WALTER A. BATES
General Manager Bates Expanded Steel Truss Company, Chicago

TWO problems immediately stand out when a manufacturer turns his eyes toward a foreign market with thoughts of increasing business. First, he must determine or at least approximate whether the eventual demand for his merchandise will be great enough to warrant the venture of establishing a foreign market. This is the deciding step. Should his assumptions be based on erroneous and misleading facts instead of concrete specific details of the various foreign markets, then the venture can do naught but fail. No herculean effort can save the situation if this first proposition is not based on sound economic principles.

The second problem is a direct function of the first. If the answer to this first question is affirmative, then the manufacturer must study the new requirements imposed upon his distribution system. This will involve further inquiries into questions ranging from policies of foreign jobbers, foreign business methods and credits to the proper methods of shipping and packing.

When we first went after a steel-pole trade in foreign fields we had varioun problems with which to contend. Among these were the establishment of acquaintance, confidence and credit. We got in touch with new markets originally through advertising in the proper mediums. Upon receipt of an inquiry we would send complete detailed information on points the prospective customer had brought out, together with as much more as experience had shown to be required. Then when an order would be received the credit situation naturally followed as the most important subject. It is our general policy to have confirmed, irrevocable credits established for sufficient time, in order to make shipments and to present documents.

The foreign buyer, however, contrary to general opinion, does not seem to object to this procedure. He takes it for granted and needs only to be met half way finally to close a business deal. Advertising can be directly credited with bringing about our Italian business, which has grown very fast. Our latest order for poles to be used in the electrification of the state railways called for 21,800 poles.

In our foreign connections we have carefully chosen only business firms of long standing and closely allied to the electrical industry. These en-

gineering houses have proved to be the very best, since we have had only one unpleasant experience in our exporting history, and that we believe was due to the world depression, directly affecting Europe, where this particular house was established.

As for the value of a steel-pole line, the foreigners, like the Americans, have been quick to appreciate that the first cost, while as low as any other type of first-class construction, has the tremendous additional value of instinctively impressing upon the bond-buying public the permanence of the security and property behind the bonds. This has been many times a deciding factor.

THE FOREIGN ATTITUDE

In the distribution development of steel poles for foreign trade we have run into many peculiar situations, each distinctly appertaining to a local situation. For instance, in some countries we found that the rules for pole-line construction required factors of safety ranging around five. Now, since most American construction is built with a factor of safety of one and a half to three, this difference must necessarily increase the investment without increasing the rate of return. Although it has been difficult to alter time-established precedents of construction, some of our efforts in reducing this extremely high factor of safety have been successful. By showing these foreign engineers that in the act of manufacture every one of our steel poles was automatically tested by the process of shearing and expanding itself and that the strength of each such manufactured pole varied but 3 to 4 per cent from an average strength, some progress has been made toward lowering the factor of safety to within reasonable limits.

Our problem of shipping and packing has been comparatively easy to solve because of the nature of the material itself. Since foreign shipments are listed either by dead weight or by the space occupied, we have been fortunate in having our poles pack so closely that it is cheaper to ship them by weight than by space. These steel poles can be grouped in a very small area since they fit together so compactly.

As a rule the foreign engineers are thorough and efficient in their examination and make purchases only after complete physical tests. All this has proved our published figures of tests and has thus established the necessary element of confidence.

Survey of Business Conditions

Motor Deliveries Begin to Require Attention

So gradual has been the improvement in the motor trade since early in 1922 that distributors and consumers have had little idea of the increasing pressure upon factory facilities which has lately begun to be felt in some quarters. The demand for both fractional-horsepower and integral-horsepower motors up to about 50 hp. rating has now attained proportions that warrant more consideration of deliveries on the part of motor dealers in their relations with manufacturers. It would be an exaggeration to say that production facilities are now being utilized to the full throughout the motor-manufacturing field, for the market is sharply competitive, and if the truth were known, patronage is undoubtedly unevenly spread around.

Motor sales agents can be found in large numbers who are on the alert to increase their regional business greatly; but, on the other hand, the tide is rising all the time, and conditions justify taking a longer look toward the future in gaging motor sales than has up to now been the rule. In a representative case deliveries now range from ten to twelve weeks on larger motors and from stock to about six weeks on the smaller and moderate-speed types. Manufacturing for factory stock is rapidly declining in face of current demand, steel delivery conditions and labor shortages. Prices are firm, and the reward of earlier ordering will be more assured shipments on promised dates, as the situation appears at New Year's.

Business Approaches Level at Peak of 1919-1920 Boom

In its ninth bi-monthly review of industrial-economic conditions in the United States, just issued, the National Industrial Conference Board says:

"The recovery of business in the United States since the severe depression late in 1920 and early in 1921 has been unusually rapid, and industrial activity today is fast approaching the level at the peak of the boom of 1919-1920. General business is probably not quite up to this point, but the general situation is sound and far better than could have been reasonably expected at the beginning of 1921 or even at the beginning of 1922.

"The business and industrial situation as a whole has shown a remarkable degree of improvement since the slump of 1920 and 1921. An index of industrial activity compiled by the National Industrial Conference Board and including seventeen of the principal basic industries of the United States showed that, compared with the monthly average for 1919-21 as a base, industrial activity for the month of October stood at 124.8. This compares very favorably with 65.7, the index number for January, 1921, and the low point since the beginning of 1915. The peak was reached in October, 1919, and the high point for 1922 so far was reached in June, when the index stood at 119.9.

"This index of industrial activity shows that the index rose 10 per cent from September to October and was 22.6 per cent higher in October, 1922, than in October, 1921. These facts indicate that industry has recovered much more rapidly than is generally supposed and that it is now at a very high point. In fact, it has been higher only on two occasions, namely, in July, 1918, and during the after-war boom in 1919 and 1920.

"During October and November there was a steady improvement in the industrial situation. Fundamental conditions have become more sound. The evidence of this is to be found in those indices which are commonly accepted as measuring business conditions. The production of pig iron and steel ingots has increased, and during October it reached the highest point since the beginning of 1921. The unfilled tonnage of the United States Steel Corporation also rose considerably, indicating that even the increased production of iron and steel during October is by no means keeping pace with demand, which continues at a high rate. Commercial failures have decreased. Railroad car loadings have reached almost record-breaking figures; in fact, car loadings for the first ten months of 1922 are higher than for any similar period."

Comparative Prices of Station Supplies

	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars, per lb.	$0.0295	$0.0295	$0.0273
Cold finished shafting, per lb.	0.0378	0.0378	0.0373
Brass rods, per lb.	0.171	0.1700	0.15
Solder (half and half), per lb.	0.24	0.23	0.20
Cotton waste, per lb.	0.11	0.11	0.112
Washers, cast iron (¼-in.), per 100 lb.	4.33	4.33	4.33
Emery, disks, cloth, No. 1, 6-in. diameter, per 100	3.11	3.11	.....
Machine oil, per gal.	0.36	0.36	.....
Belting, leather, medium, off list	30-10@50%	40-5@50%	.....
Machine bolts, up to 1-in. x 30-in., off list	55@60%	50@65-10%	50@60-10%

Prospects of Jobbers in South and West

Conditions Are More Favorable—Better Cotton in Tennessee—Building Operations in Carolinas Indicate Big Business—Optimism in Missouri—Improvement in Utah

THAT the last four months of 1922 have shown a heavy increase in Southern and Western jobbers' sales in most lines and that the year 1923 promises more prosperity than the year 1922 is seen in the four following opinions upon the outlook for the year 1923, written by leading jobbing authorities in Tennessee, the Carolinas, Missouri and Utah.

Happier Feeling Prevails

Tennessee.—W. R. Herstein, vice-president and general manager of the Electrical Supply Company, Memphis, Tenn., believes that the electrical business men of his state look back upon 1922 and forward to 1923 with a much happier feeling than that with which they regarded the outlook a year ago. He continues: "Cotton and lumber are our chief industries, as the whole world knows. The boll weevil is not altogether an unmixed evil. Things in the cotton belt are seldom normal; either we have an overproduction, with a very low price, or we have a short crop at a fancy figure. Of the two, the short crop and high price bring the greater prosperity to this section, because when the crop is long and the price low planters will not sell their cotton and cannot pay their debts. On the other hand, when prices are high, cotton moves rapidly, money comes into the country and prosperity reigns.

"During 1922 the boll weevil took about half the crop, but the remaining half will bring about as much as the total crop would have brought anyway, with the added advantage that, as before stated, cotton is now being shipped out and money is coming in.

"The housing shortage in this part of the country is not yet entirely remedied, and building progresses satisfactorily. On the other hand, we are at present undergoing a mild condition of inflation, which makes it necessary for us to watch stocks and credits carefully to avoid a repetition of 1920. If we can successfully do this, I think this section can look forward confidently to a prosperous business in 1923."

Selling the Jobber Too Well

The Carolinas.—William Farr, president and general manager of the Piedmont Electric Company, Asheville, N. C., says:

"The past two years have been years of many ups and downs. We no sooner thought we were on a straight track and ready for smooth running than we came to an abrupt turn, and the man in business today, whether manufacturer, jobber or dealer, to succeed must have the ability readily and quickly to adapt himself to circumstances, not only adjust himself, but be able to take advantage of them.

"Lately we have sensed a certain amount of pessimism expressed by manufacturers when they send out inquiries to the jobber to ascertain what his demand will be beyond his present requirements, the jobber having in mind the hand-to-mouth buying of the dealer. There is no one especially to blame for this condition, but, rather, let us put the responsibility on all of them. In the first place, the manufacturer in many cases does not insure the success of his line by an efficient sales organization, or if he has a good selling organization, he doesn't seem to have any plan. Too much is spent on 'selling' the jobber and too little on 'selling' the public. The jobber, in turn, scatters his efforts over too wide or too large a line, and in some instances he does just about as much good as a hunter going out to kill a bear with a shotgun that's loaded with bird shot. We believe that the jobber who best serves his trade and is the best customer for the manufacturer is the one who concentrates on certain lines of one manufacturer. There are enough lines to go around, so that each jobber could specialize. It's done on appliances; why not in general supplies?

"Some of the contractors are already aroused to the fact that they have let slip from them a line of business that would have been most profitable and that belongs to them by reason of their electrical knowledge; that is, supplying their home-town trade with electrical appliances, and not only supplying their customers' wants, but creating a demand and following up the 'prospect' half sold by the national advertising of some of our best-known lines. It's quite apparent from a review of the advertising columns in most of our large newspapers that the dealer has no faith in advertising, while the jobber indulges in it to a very limited extent.

"The report of building operations in the Carolinas for the last three months of 1922 indicates that we shall see big business along that line in 1923; for although for the last three months of 1922 there was a decrease of 10 per cent in the number of building permits as compared with the corresponding period of the previous year, the value of the buildings for the same period in 1922 was 22 per cent greater than in 1921."

Vigorous Building Activity

Missouri.—"The outlook for 1923 in affairs electrical is distinctly one of encouragement," says J. L. Buchanan, president of the Wesco Supply Company, St. Louis.

"In the public utility field in this vicinity there are a number of important power-house projects in active course of construction. These are not only potent consumers of electrical material now, but presage with their completion an added stimulus to the more general use of electricity in the territories served.

"The vigorous building activity promises an improving market for wiring materials, and a healthier railroad situation means busy industrials with consequent demand for motor-control devices, etc.

"In the merchandising field distinct progress is in view, with a great leader in the central-station industry giving this subject time and study and with large manufacturers duly organized for analysis and action.

"Beyond all of these things, the most hopeful sign is the increasing evidence on every side of the realization that there is no substitute for hard work."

In Sight of New Prosperity

Utah.—J. A. Kahn, president of the Capital Electric Company, Salt Lake City, Utah, states:

"In no section of the country has the business depression been more general and persistent than in the Intermountain region. This is accounted for by the fact that the three basic industries —mining, agriculture and stockraising —have all been hard hit by the slump in prices.

"It seems, however, that we are now emerging into the light of a new prosperity. The last four months of 1922 have shown a particularly healthy increase in volume of sales in most lines. The average increase for the year over 1921 in the electrical industry is somewhere within the range of 10 and 20 per cent.

"A much better showing would have been made had agricultural conditions not been in such a demoralized state. Prices for farm crops have been altogether inadequate, and a lack of cars for shipping at crucial periods has greatly aggravated the situation. The sugar industry, however, is in a much improved condition, growers receiving better prices and acreage yields showing to advantage.

"The prospect for improvement is encouraging. Big coal and iron development projects are about to be undertaken, outside capital having taken a keen interest in the vast resources of this region. Within the next few months millions of dollars will probably be expended in lands, equipment, building and labor. The manufacture of pig iron on a large scale will be a great stimulus to business and industry in this section.

"Natural gas in commercial quantities has recently been discovered at a point near enough to Salt Lake City and Ogden to make its utilization for domestic and manufacturing purposes quite certain. Copper, silver, lead and coal mining have all been resumed on a much better scale. Building in 1922 has been confined almost exclusively to residences. In the coming year larger construction jobs will likely be undertaken.

"Although the gain for the past year has not been so satisfactory as business men had hoped it would be, yet there is every reason for an optimistic outlook for 1923."

Steam Turbine Business for 1923

Says Demand Will Exceed Supply—Growth of Central-Station Load During 1922 Has Been So Great that Purchases Have Absorbed Production

BY E. H. SNIFFIN
Manager Power Sales Department, Westinghouse Electric & Manufacturing Company

THE volume of business that will be placed in 1923 for prime movers will be limited only by the manufacturing capacity; the demand will exceed the supply. The growth of central-station load during 1922 has been so great that the purchase of new generating capacity during the past six months has pretty well absorbed production, in large units at least, for the greater part of the new year. On top of this there is in active negotiation additional business equal to four or five months of the builders' capacity.

Production of steam-turbine generating units will be very large during 1923. For the greater part of two years production has been light, as there was a dearth of new business during the eighteen months' period ended last summer. Prime-mover installations involve new construction, and new construction means new financing. When the money market is easy the turbine business is good. When money tightens the central stations are forced to get along with what they have, often crowding everything to the limit to meet the public demand. There are few businesses where the future requirements can be predicted with greater accuracy. And it is one of the anachronisms of the business, from the standpoint of both the central station and the manufacturer, that we cannot establish a more even rate of production, year in and year out, for this product, whose use after all is predicated upon a very even increase in public demand. If we assume, which we can do, that the average increase in central-station load is so much per year, then some way might conceivably be found to bring the country's production facilities to approximately that same uniformity. The result would be a vast improvement in public utility service. It would avoid the present condition of laying off thousands of skilled mechanics one year and trying to find them the next. And it would reduce the cost of everything by giving a more uniform load to the manufacturing plants.

Are we treating labor or capital fairly in thus persisting in our economic blindness? Shall we continue to have our great industrial plants sometimes too small for the country's demands, but withal working on an average load factor of less than 50 per cent? It cannot be argued that this is a chimerical hope which runs counter to the law of supply and demand, for the public demand for electrical power is a very constant and assured fact, a more tangible, a more definite and predictable basis for security issues than most other business undertakings. Let us hope that the whole electrical industry, and the financial world as well, will try to find the means of remedying this regrettable condition.

The Metal Market

Copper Buying Improved—Lead Is Inactive—Tin Consumers Seem Well Supplied

Buying of copper is somewhat better than usual, but not at all phenomenal, as higher levels in the market have been quoted. For some time producers in general have been well sold up, so at the first sign of a strengthening in price they are preparing to hold a little above the market and see if the price will come up to their quotations. The lead market for the week has not been unusually active, and the advance by the smelting company last week came as a surprise to most followers of the market. The increase in price resulted from strong fundamental conditions, from the continued excellent demand of the paint, cable, battery and ammunition makers, all of whom are specifying rather more than expected, and from the fact that production has not been stimulated by higher prices to the extent that had been hoped. There seems to be sufficient lead to meet the demand at present prices in all markets. Price premiums are quoted for spot supplies, with little or no demand. Demand for tin continues almost non-existent, consumers appearing to be well supplied with all of the metals they need for present requirements. Prices have, of course, followed London, but have ruled somewhat below parity.

NEW YORK METAL MARKET PRICES

	Dec. 20, 1922 Cents per Pound	Dec. 27, 1922 Cents per Pound
Copper		
Electrolytic	14.00	14.50
Lead, Am. S. & R. price	7.10	7.25
Antimony	6.50	6.40
Nickel, ingot	36.00	36.00
Zinc, spot	7.05	7.05
Tin, Straits	37.00	38.00
Aluminum, 98 to 99 per cent.	22.50	23.00

Collections in the Northwest Are Slightly Improved

Collections in the Northwest are slightly improved. For November the record was forty-seven days for outstanding accounts. Contractor-dealers are paying a little more promptly, although in general they are slow. Jobbers are compelled to be strict in the extension of credit in this direction, for many firms are still in a precarious condition financially. The probability is that the number of doubtful accounts that the jobbers will be compelled to write off their books for this year will be greater than it has been for a number of years.

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

STOCKS of appliances are low owing to the unusually heavy buying of holiday goods during the holidays. Radio stocks also are low because of the increased interest during the last few weeks. Weatherproof wire advanced slightly last week, although demand is only fair. Fixtures are going in better volume, the residential types apparently selling best. A slight increase in activity for smaller motors is reported in the larger cities of the East and Middle West. Lamps are moving in greater volume. The conduit shortage is more acute with little relief in sight.

New York

Appliance Sales Heavier than a Year Ago—Wire Stocks Improved—Lamps Active

Sales of appliances during the last two weeks, according to several jobbers, were much heavier than a year ago, and in some instances stocks were almost depleted. A pick-up in the motor market is reported, the smaller sizes selling in better volume. Wire stocks are somewhat improved. A scarcity of conduit continues, with little hope for relief in the near future. Stocks generally are lower in preparation for the inventory period.

Lamps.—Much improvement is reported. Replacement business is slightly better but the bulk of orders is going to the recently constructed residences and stores. A slight falling off in the sign industry is reported. Stocks are ample.

Wire.—An advance of 1 cent in the base price for weatherproof is the feature of the week's market, although sales are not great. Lamp cord and other rubber-covered is selling in greater volume than for some weeks past.

Motors.—Some authorities say that 1922 motor sales are approximately 20 per cent higher than they were in 1921. Smaller motors are receiving the most attention in the present market. Stocks are ample and prices generally are firm.

Fixtures.—Heavy gain is reported in residential fixtures, as well as for commercial types. Stocks are high.

Radio.—Better broadcasting is helping radio considerably. Sales during the holidays are said to be very satisfactory. Greatest demand has been for the small crystal sets. Other parts are moving well. Heavy competition has caused prices for the low-quality sets to fall.

Boston

Appliance Business Rises to High Peak —Motor Deliveries Are Slower— Prices Stiffening

A sharp peak in the demand for appliances of all sorts featured the week just closed. Leading jobbers were practically cleaned out of electrical gift goods in some cases by Saturday. General business in New England is well maintained, but buying for stock has dropped to insignificant volume as the inventory period arrives. Building and engineering contracts in New England continue to run far ahead of last year, the total for the week ended Dec. 19 being $6,072,500, against $4,131,000 for the same week in 1921. Prices are firmer on wire and flexible armored conductor. Deliveries are causing some anxiety.

Wire.—Weatherproof wire is up 1 cent on the base price, though sales are moderate. Rubber-covered wire is moving actively. Stocks are ample and shipments in good shape from the factories.

Motors.—Sales in this district will run 25 to 35 per cent ahead of last year, from all appearances. Deliveries tend to lengthen somewhat as the demand grows and existing factory facilities are absorbed.

Lamps.—While New England has not shown the expansion in lamp business reported from some other sections, the year's total will probably run better than 1921 in many sizes and types. The long strikes in the textile mills hurt buying, and only recently have orders begun to hit substantial volumes. General lamp purchases by the public have increased by leaps and bounds this year. Prices are steady. Portable lamps were in such demand last week that motor-truck shipments from factory to retailer were necessary in some cases.

Rigid Conduit.—Stocks are spotty and the demand is pressing the supply hard. Considerable "pick-up" business is a feature of current sales. Arrivals of carload shipments from the factories are irregular.

Radio Equipment.—The holiday trade increased to a whirlwind finish at the week end. More diversified broadcasting programs and improved transmitting apparatus have stimulated the response of a critical buying public. Retail prices are widely variant on competitive tuning coils, telephones and other parts, but the better-known established sets were selling on fairly firm lines as the week closed. Unquestionably some retailers were overstocked at Christmas.

Cross-Arms.—Healthy sales are reported by jobbers catering to public utility needs. Deliveries are reported good and prices firm.

Appliances.—An overwhelming wave of buying swept this district last week and New England factories were striving hard to meet rush-order conditions. Two large jobbers reported being nearly shorn of appliances Saturday. Socket devices for table and other home use were in chief demand, and even the larger units like washers hit a swift pace.

Chicago

Christmas Appliance Trade Overshadows Standard Wiring Materials— Radio Improving

Trade in the electrical industry this week has devoted more attention to the Christmas buying of appliances than to the stable jobbing lines. Call for electrical trains and tree-lighting outfits has been very good. Dealers report their stocks depleted on both these items and lowered on the regular line of heating appliances. Comparative figures of Christmas activity are difficult to obtain, but all jobbers state that their 1922 business is above that obtained in 1921.

Chicago building permits for the thirteen months ended Nov. 31 total $213,881,450. For the first eighteen days of December permits listing $12,859,950 were registered. This year will show the largest value in building construction in the history of Chicago.

Wire. — Demand for rubber-covered wire is good, but the seasonal slump has started. Stocks are fair.

Conduit.—Stocks are still low and the demand has fallen off.

Flexible Armored Conductor.—Action on this conductor is still sluggish. Stocks are normal.

High-Tension Equipment.—Sales are still active as reported by all manufacturers. One firm sold four outdoor substations ranging from 33,000 volts to 135,000 volts with capacities of 600 kw. to 6,000 kw. Some of this equipment goes to a Middle Western utility. Another company has sold sixty 15,000-volt fuse mountings and fuses, while another concern received orders for some 66,000-volt outdoor substation equipment for a utility in Illinois.

Safety Switches. — The 30-amp. size has been in active demand until the seasonal drop in building construction. Stocks are fair but not excessive.

Lamp Cord.—Christmas trade is requiring a steady volume of both the cotton and silk No. 18.

Radio.—Jobbers report that the local demand has been more for standard well-constructed sets than for parts to construct a set. Stocks are in good shape.

Motors.—Demand is active with normal stocks.

Cleveland

Unusually Heavy Buying of Appliances —Improvement in Lamps—Steady Demand for Wire

Jobbers report unusually heavy buying of appliances and radio. The motor market is somewhat improved, the smaller sizes selling in better volume. Business in lamps is improved. Collections are slightly slower owing to the holidays. Fixtures for residences are moving more actively.

Wire.—Demand for rubber-covered is steady. Stocks are normal and prices generally are firm.

Conduit.—Scarcity of stocks is more acute, demand is increasing and prices are firm.

Industrial Equipment.—Demand remains steady. Stocks are normal and prices firm.

Fixtures.—Much improvement is evident. The industrials are taking most of the orders and there is a slight pick-up in residential business. Prices generally are firm.

Lamps.—Recently constructed residences and buildings are taking heavy stocks of the better grades. Some improvement in replacement business is reported. Stocks are ample, according to most of the jobbers.

Motors.—Demand for the smaller sizes is noticeably better. Prices generally are firm with normal stocks.

Radio.—Holiday buying has been most satisfactory. Prices on some inferior sets have been materially reduced because of keen competition. Stocks are ample.

Atlanta

Retail Trade Exceeds Expectations— Radio Moving Briskly—Dry Battery Prices Steady

Retail trade in all lines for the past week has exceeded all expectations. In the electrical business the sales of hollow ware, heating devices and portable lamps have been highly satisfactory and carry-overs from the holiday season will be comparatively light. Business in wholesale lines has also been good, particularly in the hardware and building supplies lines. It would appear that we will enter the new year with what will almost approach a business boom, with building permits in Atlanta the greatest in its history and bank clearings well in excess of those of 1921. A general spirit of optimism is apparent throughout the section, and this spirit is being encouraged by the large number of inquiries and investigations looking toward the opening up of new manufacturing and commercial establishments. Heavy rains have fallen throughout the section in the past week, and power curtailment which was feared in some sections and a fact in others is now a thing of the past.

Radio.—As a reflection of the recent radio show held in Atlanta, together with the holiday demand, this line is

moving briskly and all jobbers have good stocks on hand. Prices are firm, but reductions are expected in March.

Wire.—Both weatherproof and rubber-covered wire are moving briskly and jobbers' stocks are only fair. Deliveries are reasonably satisfactory and stocks will be brought to normal after the inventory period. Prices are advancing.

Dry Batteries.—Stocks have been allowed to run down, but deliveries are good and jobbers are having no trouble filling the satisfactory orders.

Outlet Boxes.—A healthy movement continues with stocks reported as fair to good.

Pole-Line Hardware.—A brisk movement is reported, this having been the case for several weeks. Stocks are only fair and deliveries are not all that might be asked. Some price advances have been reported.

Lamp Cord.—A good movement is reported with fair to good stocks on hand. Deliveries are only fair and some price advances have been reported.

St. Louis

Stocks Generally Are Low—Meters Show Improvement—Porcelain Steady—Transformers Active

Jobbers and dealers devoted most of the time last week to handling the exceedingly attractive volume of holiday purchasing. Final figures are not yet obtainable, but without question total sales were considerably heavier than last year and it is possible that this is one of the best years ever experienced. Stocks were initially low, purchasing was continually on a conservative basis, and consequently the carry-over will be quite nominal. Immediate orders will have to be placed in some lines for stock replenishment. In the regular power and wiring lines there was little development during the week, though demand remained consistently steady, and improvement is noted in weatherproof wire and in meters.

Merchandise.—Short stocks exist in waffle irons, percolators and radiant heaters, and low stocks obtain in virtually all lines of heating appliances. Ample stocks remain in the larger items, such as ranges, washing machines and vacuum cleaners.

Conduit.—Shipments reported en route will materially build up the now depleted stocks. A steady demand continues and no great diminution is anticipated because of the continued large building program.

Porcelain.—Demand is steady with ample stocks and firm but competitive prices.

Schedule Material.—A decline in sales, thought to be of temporary nature, was experienced last week. A readjustment of prices, without materially affecting the average level, is anticipated.

Pole-Line Hardware.—Business is comparatively quiet, what demand there is being principally for interconnection of small power systems, but prospects are excellent for next year. Stocks are normal and prices firm.

San Francisco

Conduit Stocks Are Very Low—Rubber-Covered Wire Sales Good—Radio Improving

From present indications, the labor shortage will be the only hindrance to a wonderful building year for 1923. Those conversant with conditions predict 50 per cent increase over the building of this year. Even now every available man is working. Stocks generally are good. Conduit, however, is still several months behind. Seasonable crops are progressing nicely. Heavy rains, for instance, will cause a record-breaking rice crop, which will materially increase the prosperity of the Sacramento valley and reflect it upon Sacramento and San Francisco. Holiday business has been good but not exceptional. Better merchandising in windows and advertising by electrical dealers is perceptible to most casual observers. The California Electrical Co-operative Campaign has distributed sales helps at nominal cost and is endeavoring to popularize a distinguishing trade-mark for progressive dealers. New cooking and heating rates are, it is rumored, to become effective soon after the new year.

Wire.—Rubber-covered-wire sales are good. Threatening shortages have been avoided by timely shipments. Prices are fairly stable, but this condition is said to be a lull before an increase in business.

Conduit.—The existing situation will probably hold well into February; that is to say, five cars needed for every car received, particularly in the Los Angeles territory.

Poles and Cross-Arms.—Mill yards are well stocked, but car shortages have prevented assembly of more than adequate emergency stocks in California yards.

Radio.—A perceptible improvement in sales immediately followed broadcasting improvement. Several new stations are under construction. Retail holiday business was excellent, particularly in department stores.

Portland-Seattle

Jobbers' Business Very Active—Many Stocks Low or Exhausted—Hardware Advancing

Lumber production for the past week was 13 per cent below normal. This probably is a prelude to the usual holiday lull, but weather conditions at present indicate presumption of logging soon on an appreciable scale. This will further improve the employment situation, which, however, is in much better shape than it was a year ago. The very pleasant weather of the past week has stimulated buying, and retailers feel gratified over the result. This year's business in most cases will far exceed last year's for holiday trade. Jobbers report business very active and many stocks low or exhausted. The holiday demand appears heaviest in Christmas-tree outfits, radio material and heating appliances, such as air heaters, percolators and accessory materials, waffle irons, toasters, etc. In many cases the stocks are out because manufacturers could not fill the jobbers' orders.

Pole-Line Hardware.—Stocks are reported to be once more in good condition. An advance of 6 or 7 per cent is reported in some lines of wiring devices. In some cases an advance of 5 per cent is reported on weatherproof wire and rubber-covered wire in the smaller sizes.

Salt Lake City

Survey of Jobbers' Reports Shows that Few if Any of Them Have Made Large Money

A survey of jobbers' business charts for the year 1922 shows that few if any of them have really made large money. There has been a steady gain, however, in the past three months. If the rate of progress can be held, 1923 should show the jobbing business in electrical lines on a stable and paying basis. Retailers report good sales for December, while jobbers say there has been a noticeable let-down from November. This is accounted for by the fact that jobbers meet the holiday demand a month in advance of the retailers. Collections show slow but steady improvement and the money market is easier.

Panelboards and Switchboards.—Factories report business good both in the construction of new apparatus and in repairs. The building programs for the coming year foreshadow a big volume of work in this line.

Denver

Light Demand for Armored Cable Believed Temporary—Advance in Conduit Anticipated

Holiday business has been most satisfactory. Jobbers report depletion of appliance stocks and all Christmas merchandise dealers' shelves are practically emptied. With good business in heavier appliances, such as washing machines and vacuum cleaners, in some cases retail volume has been twice that of Christmas business a year ago.

Armored Cable.—Unusually light demand believed only temporary. Prices are stable with ample stocks.

Conduit.—Light buying prevails, although an advance is anticipated.

Wiring Devices.—Christmas business has strengthened demand, with prices and stocks normal.

Transmission Material.—No new developments or extensions are indicated. The month's business has been quiet.

Meters.—Slow demand with normal stocks.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Automatic Electrical Devices Expands 300 per Cent

The Automatic Electrical Devices Company, manufacturer of electrical and automotive devices, Cincinnati, has expanded its manufacturing facilities 300 per cent during the past year. "The business outlook for the next six months is exceedingly promising," says C. E. Ogden, president and general manager of the firm, "and our December sales promise to be even greater than those of April, in which month our sales were over double those of the entire year 1921. We believe that the same volume of business is available for at least four more months, or until warm weather again affects buying in the radio industry."

Hugo Reisinger Will Handle Conradty Carbons

Hugo Reisinger, 11 Broadway, New York City, importer for many years of "Electra" carbons, announces that he will handle in the future a complete line of carbon products manufactured by C. Conradty, Nürnberg, which consist of high-grade carbon and graphite brushes, also the "Bronskol" metal brush, which has been used in this country with great success, as well as furnace electrodes and "Ocelit" resistance material.

Master Electric Company Gives Insurance to Employees

An insurance policy with premium paid is a Christmas gift which has been received by each employee of the Master Electric Company, Dayton, Ohio. The insurance policies given by this company range from $500 up and are with an old-line insurance company. A feature of the gift is that the policies will be increased each succeeding year to a limit of $2,000, and all premiums will be paid by the company while the employees remain with the organization.

In presenting the policies E. P. Larsh, president of the company, announced the initiation of a nursing service which will provide nurses free of charge to employees who are ill during their connection with the Master Electric Company.

Mr. Larsh said in discussing the gift "It is an expression from this company of our appreciation for the faithful service which all of our employees have rendered. Our growth has been unusually rapid, and we feel that much of what we have been able to accomplish we owe to the hearty co-operation of our employees. Therefore we are taking this Christmas season as a fitting time in which to express our appreciation in this way."

It was also announced that the business of the company for the last quarter of this year was four times greater than the volume for the same period last year. This increase in business made necessary the moving to a larger plant where it now has ample facilities for handling its growing business.

Robbins & Myers Company Holds Sales Convention

The Robbins & Myers Company, Springfield, Ohio, manufacturer of electric motors, generators and fans, held an important sales convention in Springfield during the week of Dec. 11, when matters pertaining to its sales policies were discussed.

On Monday, Dec. 11, a general meeting was held in the offices of the company, where introductory talks were given by F. S. Hunting, president; W. J. Myers, vice-president, and H. E. Freeman, treasurer. In the afternoon a trip through the factory was made.

During the following days of the week addresses were given by the following members and officials of the company: H. R. Stuart, chief engineer; H. I. Smeltzer, in control of production; T. Groner, production manager; W. A. Lubbers, chief inspector; D. F. Alexander, chemist; W. L. Wood, cost department manager; C. H. Clark, advertising manager; W. W. Mumma, sales manager; F. M. Webber, assistant sales manager for motors; F. W. Burmeister, assistant sales manager for fans; E. Wilson, auditor; F. G. Ziegler, credit manager; F. H. Andrews, purchasing agent, and C. F. Hellwig, traffic manager.

Line Material Company Holds Sales Convention

The Line Material Company, Milwaukee, held its annual sales convention Dec. 17 to 22, at the Hotel Martin, in that city. C. P. Wagner of the Minneapolis General Electric Company gave a talk on secondary and sectionalizing fuses and their use by his company. Arthur J. Sweet, consulting illuminating engineer and an officer of Traficon, Inc., lectured on street traffic control and regulation. Dan Wescott, president of South Bend Current Control Company, demonstrated RC-OC switches. Those in attendance were W. D. Kyle, president of the Line Material Company; L. E. Hendee, sales manager; J. D. Hoit, Albany; J. J. Desmond, Chicago; K. W. Kline, Kansas City; D. H. Millar, Des Moines, Iowa; A. L. Dunmire, Oakland, Cal.; I. W. Bolton, Milwaukee; L. A. Priester, Dallas, Tex.; C. A. Moore, Charlotte, N. C.; L. A. Greff, New York; H. E. Miller, Philadelphia; P. L. Reeves, Boston; E. R. McCoy, Indianapolis; P. O'Moore, Pittsburgh; E. W. Merriam, Hartford, Conn.; F. T. Otis, Richmond, Va.; F. T. Buckley, Little Rock, Kan., and P. R. Gossman, Dubuque, Iowa.

Sundh Electric Company Changing Charter to New Jersey

For reasons of convenience in its corporate management, the Sundh Electric Company, 209 Parkhurst Street, Newark, N. J., is changing its corporate charter from the State of New York to the State of New Jersey. According to the company, this action is being taken with unanimous consent of the directors and stockholders, and it is stated that the New Jersey company will assume all the liabilities of the New York company. According to the announcement, there is to be no change whatever in the conduct of business.

Royal Cleaner with Attachment Set Price Is Reduced

The P. A. Geier Company, Cleveland, manufacturer of electrical appliances, has perfected a new complete set of attachments for the Royal electric cleaner. The company says in a letter to the trade that the retail price of the Royal electric cleaner complete with this new set of attachments is $65 instead of $67.50, which was the former price. The price of the cleaner alone remains the same.

The Power Specialty Company, builders of "Foster superheaters," economizers and oil heating and cooling equipment, announces the opening of new branch offices in Detroit, Dime Savings Bank Building, in charge of L. Lanyi, and in Boulder, Col., 2,324 Fourteenth Street, in charge of R. B. Nutting, who was formerly Chicago district manager.

The Robinson Electric Company, 1135 North Fortieth Street, Philadelphia, has acquired property at 807 Race Street and will use it for a branch establishment.

The Evans Lead Company, recently organized as a subsidiary of the Ohio Alloy Company, Fostoria, Ohio, with a capital of $1,000,000, has plans in progress for a new plant at South Charleston, W. Va., where 15 acres have been purchased. It will consist of two main units, of four stories and one story, each 50 ft. x 180 ft., for the manufacturer of lead products, and is estimated to cost $100,000. S. M. Evans is president of both organizations.

The Acheson Graphite Company, Buffalo Avenue, Niagara Falls, N. Y., manufacturer of electrodes, electrical specialties, etc., is planning for the erection of a one-story addition.

Foreign Trade Notes

ELECTRIC EQUIPMENT FOR BRANDFORT, SOUTH AFRICA.—Tenders will be received by the Municipal Council of Brandfort, Orange Free State, South Africa, until Jan. 30, for water-tube boilers, steam engines and alternators, switchboard, boiler and engine-house auxiliaries, material for distributing system, transformers, meters, etc.

PROPOSED HYDRO-ELECTRIC PROJECT AT BURRINJUCK, AUSTRALIA.—Plans are being prepared for the proposed hydro-electric project at the Burrinjuck (N. S. W.) dam, which will supply electricity over a wide area, including the towns of Jugiong, Cootamundra, Gundagai, Junee, Harden, Murrumburrah, Young and Yass. Preliminary work in connection with the scheme, including surveys for the transmission lines, has been completed. The initial work will include the construction of the tunnel from Burrinjuck to the power house and foundations for the power house, for which tenders will be invited. Separate tenders will be asked for equipment for plant.

PROPOSED HYDRO-ELECTRIC PROJECT IN BRAZIL.—The Brazilian government has approved the plans submitted for utilizing the falls of Mambucaba, situated on the frontier line between the States of Rio Janeiro and São Paulo. It is proposed to form a syndicate to nstall the proposed hydro-electric plant and distributing system. The reservation of an area of 12,300 hectares of land which can be devoted to any useful industrial purpose is included in the project.

IMPROVEMENTS TO THE LIMA (PERU) STREET RAILWAY AND ELECTRIC SERVICE.—A contract has recently been executed between the municipality of Lima, Peru, and the Empresas Electricas Asociadas, *Commerce Reports* states, whereby improvements will be made at once in the local street-railway system and electric power service. The capital which will finance the improvements, it is understood, will be furnished by the Latino-Lux, an Italian corporation.

NEW EQUIPMENT FOR THE KARACHI ELECTRIC PLANT.—To provide for the extension of its electric lighting service into the native quarters of the Karachi municipality, the Karachi Electric Supply Corporation, *Commerce Reports* states, will require additional electric generating units. On account of the proximity of the Persian oil fields it is probable that Diesel engine units, similar to those now installed, will be most favorably considered.

PROPOSED HYDRO-ELECTRIC PROJECT FOR NELSON, NEW ZEALAND.—Permission has been granted the Waimea Electric Supply & Manufacturing Company, Ltd., Nelson, South Island, New Zealand, according to *Commerce Reports*, to utilize 60 cu.ft. per second of the waters of the Walroa River in the district of Nelson to generate electricity. The plant is to be completed within one year from the date of the license, July 31, 1922.

ELECTRICITY TO BE TRANSMITTED FROM SWITZERLAND INTO FRANCE.—Arrangements have been made for the transmission of electricity from Switzerland into France at 135,000 volts by a transmission line to start from Miécourt, Switzerland. This line is to be linked to the network of the Berner Kraftwerke, which owns the station of Olten-Gosgen, Muhlberg. The amount of energy to be transmitted will be 28,000 kw., which will supply the Mulhouse district (the transformer station being at Ile Napoléon), the districts of Colmar and Münster, and will be tied in at Wintzenheim-Turckheim to the existing 70,000-volt transmission line of the Société d'Electricité de Strasbourg. It will be continued to Sarrebourg-Creutzwald by a 70,000-volt transmission line to Solec, now under construction by the Société Alsacienne et Lorraine d'Electricité. Work has not yet started on the erection of the transformer stations, but will be soon. A station will be erected at Kembs in the near future, and probably a pumping station will be built in the valley of Kaysersberg (Upper Rhine), the Commission du Rhin having agreed to the French utilizing the waters of the Rhine.

ELECTRIFICATION OF BRICKYARDS IN NORWAY CONTEMPLATED.—Experiments have been carried on in western Norway, near Sandnes, *Commerce Reports* states, in operating brick ovens by electricity. The oven used was of American type, adapted to this special use, and the trials are said to have been very successful. Besides burning brick, it is said that the new electrical oven could be also used for the burning of lime and even in pottery works. At the brick yard near Sandnes, where about 10,000,000 bricks are manufactured annually, it is estimated that 10,000,000 kw.-hr. of electrical energy would be used, or about twice the quantity which is consumed in that community at present.

New Apparatus and Publications

ASH EJECTOR.—The Victor Engineering Company, Philadelphia, is distributing a booklet describing the "Victor" ash ejector.

COAL STORAGE.—"Storing Coal Safely" is the title of a booklet issued by the Protectometer Company, 154 Ogden Avenue, Jersey City, N. J., in which it demonstrates the use of the "Fedco Protectometer System" for temperature observations in connection with the storage of coal.

MOTORS AND GENERATORS. — The Burke Electric Company, Erie, Pa., is distributing a four-page pamphlet covering its various types of direct-current motors and generators.

ELECTRIC MOTOR TRUCKS. — The Commercial Truck Company, Philadelphia, has issued a catalog covering its two-motor and four-motor drive "C-T" electric trucks. Bulletin No. 21 issued by the company contains an article on the design and construction features of its two-motor concentric-gear-drive trucks and its four-wheel internal-gear-drive trucks. "Why You Should Use 'C-T' Electric Trucks" is the title of bulletin F-16, which gives some pertinent facts regarding its trucks. The company is distributing several other bulletins showing the use of its trucks in various industries.

HAND TACHOGRAPH.—O. Zernickow, 15 Park Row, New York City, is placing on the American market the "O-Z" hand tachograph, a new instrument for making graphic charts, which will make records of any speeds within the ranges manufactured.

HELICAL GEARS.—The Farrell Foundry & Machine Company, 344 Vulcan Street Buffalo, is distributing a booklet in which it announces that it has acquired all patent rights to the "Sykes" gear generating machinery and methods in the United States and Canada. A full equipment for producing the continuous double-helical gears by this new method will be put in operation at its Buffalo plant.

ADJUSTABLE LIGHTING FIXTURES. —The O. C. White Company, 15-21 Hermon Street, Worcester, Mass., has issued a catalog covering its complete line of adjustable fixtures.

TUBE CLEANERS. — The Roto Company, Hartford, Conn., is distributing a booklet describing the "Roto" tube cleaners, air steam or water driven, for fire-tube and water-tube boilers, fuel economizers, condensers, evaporators, feed-water heaters, etc.

STEAM-JET CONVEYOR.—The Victor Engineering Company, Philadelphia, has issued a booklet covering the "Victor" steamjet conveyor.

SPOTLIGHT.—Bulletin No. 402 issued by the National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, describes a new show-window spotlight brought out by the company.

GRAPHIC INSTRUMENTS. — "How to Make a Plant Survey" is the title of bulletin No. 1,112 issued by the Esterline-Angus Company, Indianapolis, Ind., which describes the methods and results obtained by the systematic use of graphic instruments in industrial plants.

New Incorporations

THE UPPER METHOW VALLEY LIGHT & POWER COMPANY, Winthrop, Wash., has been incorporated with a capital stock of $15,000 by R. E., Carl A. and L. G. Johnson and W. L. Chrysler.

THE EDGEWOOD LIGHT & POWER COMPANY, Port Angeles, Wash., has been chartered with a capital stock of $5,000 by A. F. Eacrett, J. D. Moran, F. P. Fisher, G. W. Critchfield and C. A. Frostburg.

THE RAYMONDVILLE (TEX.) LIGHT, POWER, WATER & ICE COMPANY, Inc., has been granted a charter with a capital stock of $40,000. The incorporators are C. A. Cripe, R. E. Harding and S. K. Gill.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOOTHBAY HARBOR, ME.—The property and franchise of the Lincoln County Power Company, consisting of power plant at Damariscotta Mills and substation at Boothbay, transmission and distributions systems, etc., have been acquired by the Central Maine Power Company, Augusta.

PORTLAND, ME. — The Cumberland County Power & Light Company has applied to the Public Service Commission for permission to acquire the properties of the York County Power Company, York, and the Westbrook (Me.) Electric Company.

MEREDITH, N. H.—The Utilities Power Company has petitioned the Public Service Commission for permission to extend its service to Tuftonborough, Bristol, Ashland Center Harbor, New Hampton and Moultonborough.

RICHFORD, VT.—The Sweat-Comings Company, which owns the local electric lighting system, has sold its property and franchises to the Clyde River Power Company, Newport, Vt.

SPRINGFIELD, MASS.—An electric interlocking system for train control and other electric power equipment will be installed in the proposed local station of the Boston & Albany Railroad, Boston, to cost about $4,000,000.

WATERTOWN, MASS.—Electric power equipment will be installed in the new local plant to be erected by the Vose & Son Piano Company, Boston, to cost about $300,000. Densmore & LeClear, 88 Broad Street, Boston, are architects.

PAWTUCKET, R. I.—The Chamber of Commerce and the Business Men's Association have petitioned the City Council to appropriate funds for the installation of an ornamental lighting system in the business district. The Blackstone Valley Gas & Electric Company furnishes the street-lighting service.

STAMFORD, CONN.—The Stamford Gas & Electric Company contemplates improvements to its plant, including the installation of additional equipment, to cost about $40,000.

North Atlantic States

BROOKHAVEN, N. Y.—The Public Service Commission has granted the Patchogue (N. Y.) Electric Light Company permission to install an electric lighting system in Brookhaven, including Middle County Road.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Flatbush Avenue Extension and Concord Street, Brooklyn, until Jan. 3 for installing electric wiring and fittings in the New Utrecht High School on Seventy-ninth and Eightieth Streets, from Sixteenth to Seventeenth Avenue.

LOCUST VALLEY, N. Y.—Electric power and pumping equipment will be installed in the proposed municipal water plant to cost about $300,000.

NORWOOD, N. Y.—The Norwood Electric Light & Power Company has arranged for an increase in capital in an amount of $145,000, part of the proceeds to be used for extensions and improvements.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Flatbush Avenue Extension and Concord Street, Brooklyn, until Jan. 3 for additions and alterations to electrical equipment, bell and fire signal systems, and fire protection work at Public Schools 11, 13, 28 and 36, Borough of the Bronx. Also for installing electric wirings and fittings in new Public School 65, Borough of the Bronx.

PLATTSBURG, N. Y.—The Plattsburg Gas & Electric Company has applied to the Public Service Commission for permission to exercise franchises granted by the towns of Beekmantown, Chazy, Schuyler Falls and Saranac to furnish electricity in those places.

SARATOGA, N. Y.—A power house will be erected at the Saratoga Hospital, to cost about $45,000. William H. Vaughan, 400 Broadway, is architect.

WATERTOWN, N. Y.—The directors of the Northern New York Utilities, Inc., have authorized an application to the Public Service Commission for permission to sell certain undeveloped water-power rights and its small plant at South Edwards to the Power Corporation of New York, which proposes to develop a large hydro-electric project at that location.

ELIZABETH, N. J.—Bids will be received by the board of education until Jan. 11, 1923, for construction of new additions and alterations in Public School No. 12. Separate bids to be submitted on electrical, plumbing, heating and ventilating work. C. Godfrey Poggi, 275 Morris Avenue, is architect.

HOLLAND, N. J.—Surveys are being made by the Pennsylvania-Edison Company, Reading, Pa., for the construction of a new generating plant at Holland, to cost about $5,000,000, with transmission lines. The ultimate cost is estimated at $10,000,000.

RUTHERFORD, N. J.—Steps have been taken by the Chamber of Commerce and other civic organizations for the installation of an ornamental lighting system on Park Avenue. The Public Service Electric Company furnishes the street lighting service.

TRENTON, N. J.—Plans are under consideration for the installation of an ornamental lighting system, using joint poles with the local traction company.

ALLENTOWN, PA.—The Pennsylvania Power & Light Company contemplates extending its transmission system in Upper Augusta Township and Snydertown. The company has acquired the Conyngham (Pa.) Power & Light Company and plans for extensions and improvements in the system. A transmission line will be erected to Shenandoah via Hometown, Tammenend and Delano.

BLOSSBURG, PA.—Gannett, Seelye & Fleming, Inc., engineers, 204 Locust Street, Harrisburg, and other Harrisburg interests have acquired the property of the Blossburg Electric Light & Power Company and also the electric plant at Mansfield, Pa., which they plan to consolidate, making considerable improvements and extensions. The item which was published in the issue of Dec. 23 stating that the property of the Blossburg Electric Light & Power Company had been purchased by E. L. Phillips & Company, New York City, was not correct.

PHILADELPHIA, PA.—The American Ice Company, Sixth and Arch Atreets, will install electric power equipment at its new ice-manufacturing plant at Washington and Seventeenth Streets, to cost about $75,000.

SUSQUEHANNA, PA.—The Susquehanna Light & Power Company is considering an issue of $100,000 in bonds, the proceeds to be used for extensions and improvements.

FREDERICK, MD. — Steps have been taken by the Chamber of Commerce for the installation of an ornamental lighting system here.

HAGERSTOWN, MD.—Electrically operated pumps will be installed at the municipal waterworks station in connection with proposed extensions and improvements, to cost about $100,000.

LOGAN, W. VA.—The Kentucky & West Virginia Power Company contemplates extension and improvements to its local plant, to cost about $750,000. Francis R. Weller, Mills Building, Washington, D. C., is consulting engineer.

WESTON, W. VA.—The Weston Electric Light, Power & Water Company is preparing plans for extensions and improvements to its system, to cost about $40,000.

RICHMOND, VA.—Bids will be received by the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 4, for a full magnet-control electric elevator at the local post office.

TAPPAHANNOCK, VA.—Bonds to the amount of $15,000 have been voted for an electric substation and distributing system.

North Central States

CARO, MICH.—The Consumers' Power Company, which has acquired the local electric plant, contemplates the erection of a transmision line from Zilwaukee to Caro for local service.

ST. CLAIR, MICH.—The Detroit Edison Company will make extensions and improvements to the local street-lighting system.

HAMMOND, KY.—The Big Four Coal Company, Whitesburg, contemplates the installation of electric equipment and other machinery at its properties at Candill, near Hammond.

LOUISVILLE, KY.—The Louisville Gas & Electric Company contemplates installing another generating unit and auxiliary equipment at its Waterside power plant.

LOUISVILLE, KY.—The City Council has engaged Gen. W. L. Sibert, engineer, to investigate the feasibility of developing water power on the Ohio River. The proposed plan includes raising dam No. 41.

MARION, KY.—A power house will be built by the Big Four Fluorspar & Ore Company, Farmers' Bank Building, Pittsburgh, Pa., at its proposed local mining and milling plant, to cost about $100,000.

CANNELTON, IND. — The Cannelton Sewer Pipe Company contemplates the erection of a new clay plant, consisting of eight kilns, radial stack and a new power plant, etc., to cost about $240,000.

EDWARDSPORT, IND. — The Indiana Power Company has contracted with the Knox & Sullivan Light & Power Company for power supply for local distribution. Extension to transmission line will be made.

LAPORTE, IND.—The Laporte Gas & Electric Company has submitted two proposals to the City Council offering to rebuild the electric transmission line between the city limits and the Kankakee pumping station.

CHICAGO, ILL.—The Ford Motor Company, Detroit, will build a power house in connection with a new assembling plant on Torrance Avenue, near 126th Street.

EFFINGHAM, ILL.—The Illinois Public Service Company, Springfield, will install electric power equipment at its proposed ice and cold-storage plants at Effingham and Charleston.

WINNETKA, ILL.—A power house will be built in connection with the proposed new manual training school to be erected by the New Trier Township School Board, to cost about $200,000. Perkins, Fellows & Hamilton, 814 Tower Court, Chicago, are architects.

WATERTOWN, WIS.—Contracts have been awarded by the Perfection Table Slide Company for the erection of a two-story factory, 60 ft. x 180 ft., with separate power plant, 30 ft. x 45 ft., and an office building, 21 ft. x 30 ft., work to start about March 15. Omer L. Gaston, Watertown, is general contractor.

GOTHENBURG, IOWA.—The State Railroad Commission has given its approval of the erection of an electric transmission line which will connect the villages of Maxwell and Brady with the electric plant in Gothenburg.

MAQUOKETA, IOWA.—The Maquoketa Hydro-Electric Power Company will take bids in January for the construction of a power plant on the South Fork of the Maquoketa River, to develop 2,000 hp., to cost about $175,000. Holland, Ackerman & Holland, 53 West Jackson Boulevard, Chicago, are engineers.

ST. LOUIS, MO.—Electric power equipment will be installed in the proposed addition to the plant of the Continental (Mo.) Portland Cement Company, near St. Louis, owned by the Alpha Portland Cement Company, Easton, Pa., to cost about $500,000.

ST. LOUIS, MO.—Bids will be received by the Board of Public Service, City Hall, until Jan. 2 for construction of two-story service building and power plant, 55 ft. x 225 ft., at the Training School for Feebleminded at Scott Farm, to cost about $150,000. The equipment will include two 200-hp. oil-burning water-tube boilers, electrical apparatus, ice and refrigerating equipment, etc. L. R. Bowen City Hall, is architect and engineer.

PALMYRA, NEB.—The Nebraska City Utilities Company will extend its service to Palmyra and Julian to supply electrical service in both towns.

Southern States

ASHEVILLE, N. C.—L. B. Jackson and associates plan to install a street-lighting system at Linwood Park in connection with the development of a large tract of land for residential purposes.

BRICKHAVEN, N. C.—The Carolina Power & Light Company, Raleigh, is planning to construct a 15,000-kw steam-driven plant on the Cape Fear River, near Brickhaven. The plans provide for an ultimate development of 60,000 kw. Post office address Corinth.

ELLERBE, N. C.—Bonds to the amount of $15,000 have been authorized for the installation of an electric lighting system.

HICKORY, N. C.—Electric power and pumping equipment will be installed at the proposed municipal waterworks, to cost about $300,000. J. W. Bollen is city engineer.

ATLANTA, GA.—Electric power equipment will be installed in the proposed plant addition to be erected by the Southern Spring Bed Company, to cost about $100,000.

CAMDEN, S. C. — The Wateree Power Company contemplates extensions and improvements to its system. The company has increased its capital to $7,500,000.

MARIANNA, FLA.—G. N. Thomas and associates are planning to build a power plant on the Chipola River with initial capacity of about 3,500 hp.

PORT TAMPA, FLA.—The Atlantic Coast Line Railroad, Wilmington, N. C., contemplates the construction of a power house in connection with its proposed local shops to cost about $150,000.

FRENCH ROAD, TENN.—The Burnett Knitting Mills, Inc., will construct a steam-driven electric power plant in connection with its proposed local mill, to cost about $60,000.

JOHNSON CITY, TENN.—The Holston River Power Company has tentative plans under consideration for the construction of a hydro-electric power plant on the Holston River, with an initial capacity of about 60,000 hp.

MONTICELLO, MISS.—The McCormick Power Company, recently organized, plans to install a local distributing system. Eugene and Charles McCormick head the company.

ORVISBURG, MISS.—The Nortac Manufacturing Company, Poplarville, contemplates the installation of a power plant in connection with its proposed lumber mill in this section, to cost about $150,000.

BASTROP, LA.—The Bastrop Pulp & Paper Company will begin work at once on construction of a power house at its plant.

SHREVEPORT, LA.—A committee has been appointed by the City Council to make an investigation and secure estimate of cost of a municipal electric power plant.

MUSKOGEE, OKLA.—The Yahola Sand & Gravel Company will install electric power equipment, motors and electric pumping plants in connection with an irrigation system, in the vicinity of Fort Gibson, to cost about $250,000. W. S. Dills is president.

OKLAHOMA CITY, OKLA.—The New State Ice Company will install electric power equipment in its proposed plant at 17 West Second Street, to cost about $40,000.

WEATHERFORD, OKLA.—Plans are under way for extensions and improvements in the municipal electric power plant and waterworks, to cost about $114,000. V. V. Long & Company, Colcord Building, Oklahoma City, are engineers.

WYNNEWOOD, OKLA.—Plans are being prepared for extensions and improvements to the municipal electric plant and waterworks, to cost about $85,000. V. V. Long & Company, Colcord Building, Oklahoma City, are engineers.

BALLINGER, TEX. — An ornamental lighting system will be installed in the business district.

LAREDO, TEX.—R. W. Morrison contemplates the construction of a new power dam, about 5 miles from Laredo, to develop about 5,000 hp.

MERCEDES, TEX. — The controlling interest in the Mercedes Water, Light & Power Company has been acquired by the Morrison & McCall syndicate.

ROCKDALE, TEX.—The Texas Power & Light Company contemplates erecting a 2,300-volt transmission line to Cameron and Hearne, Tex. Other transmission line extensions will be made, including new lines in Milam County.

SAN ANTONIO, TEX.—Plans are under way for the installation of a lighting system on the Fredericksburg Road for a distance of 11 miles. The Fredericksburg Improvement Club is interested in the project.

Pacific and Mountain States

EPHRATA, WASH.—The Washington Water Power Company contemplates extensions in its transmission system in Grant County.

PORTLAND, ORE.—A construction program involving an expenditure of about $6,500,000, it is reported, will soon be undertaken by the Pacific Power & Light Company. The work will include the construction of a 10,000-hp. hydro-electric plant on the Deschutes River, 15 miles from the mouth of the river. A high-tension transmission line, 60 miles long, will be erected this winter from Kennewyck across the lower Horse Heaven district, and during the following summer will be continued to the power site; further extensions will be made during the summer from the proposed plant to the new Oak Grove hydro-electric plant

of the Portland Railway, Light & Power Company on Clackamas River, a distance of 85 miles. The cost of the transmission lines is estimated at $1,500,000.

RIVERSIDE, CAL.—The Nevada-California Electric Corporation, Symes Building, Denver, Col., is arranging an appropriation of $8,000,000 for the construction of seven hydro-electric power plants in California during 1923, with a total capacity of 36,500 hp., with transmission-line extensions.

VAN NUYS, CAL.—Electric power equipment will be installed in the ice-manufacturing and cold-storage plant to be erected by the Los Angeles (Cal) Ice & Cold Storage Company, cost about $60,000.

WILLITS, CAL.—The Central Mendocino County Power Company, which recently purchased the electric and water systems of the Willits Water & Power Company, will erect an electric transmission line at once to connect with the transmission system of the Snow Mountain Water & Power Company at the upper end of Potter Valley. A large dam will be built 2 miles north of here to provide an additional water supply for Willits and for irrigation purposes.

PAROWAN, UTAH. — Application has been filed by the City Council with the State Engineer for permission to divert 24 second-feet of water from Center Creek in Iron County to develop 600 hp. It is proposed to divert the water by means of an iron or wooden pipe line a distance of about 9,650 ft. to the power-house site at the base of the Parowan Mountain range.

SALT LAKE CITY, UTAH.—Application has been filed with the State Engineer by Clarence Snow of Salt Lake City for permission to divert 50 second-feet of water from Big Cottonwood Creek to generate electricity. The project includes a concrete diversion dam, headgate and pipe line. The plans call for a development of 4,800 hp.

PRESCOTT, ARIZ.—The Verde Valley Fruit & Produce Association plans to build a power house in connection with its proposed local fruit packing plant.

SUPERIOR, ARIZ. — Arrangements are being made by the Magna Copper Company for extensions and improvements during 1923, including a new mill with power house and the installation of considerable electrically operated mining machinery. The cost is estimated at about $3,500,000.

JORDAN, MONT.—John Harr and associates are planning to build an electric power plant in Jordan.

BERNALILLO, N. M.—The Sandoval Light & Power Company, recently organized, has arranged for the installation of a local power plant. Philip Joegels is president.

BERNALILLO, N. M.—The White Pine Lumber Company contemplates the construction of a new mill, with power house, to cost with machinery, about $500,000.

SANTA FE, N. M.—A permit has been granted by the State Engineer to Daniel L. Evans and associates to build a hydro-electric project at the mouth of White Rock Canyon, on the Rio Grande River, west of Santa Fe, to develop 15,000 hp. The cost of the project is estimated at $1,500,000.

SPRINGER, N. M.—The local electric light plant has been purchased by L. I. and Irwin Taylor. The new owners, it is understood, install new equipment and increase the service.

Canada

HUNTSVILLE, ONT.—The Muskoka Wood Manufacturing Company is rebuilding its plant destroyed by fire last June. The factory will be 75 ft. x 250 ft., equipped throughout with electrically driven machinery. The power plant will have an output of between 700 hp. and 800 hp.

NORTH BAY, ONT.—The Town Council is considering the construction of a hydro-electric plant on the French River at Chaudière Falls. The plans provide for the construction of three plants to develop 30,000 hp., to be distributed in North Bay and surrounding towns, and 35 miles of transmission lines, to cost about $3,000,000.

TIMMINS, ONT.—The Hollinger Consolidated Gold Mines Company contemplates the construction of a hydro-electric plant on Abitibi River at Island Portage. The project includes a concrete dam, power house equipped with three 10,000-hp. turbo-generators, transformers, etc., and about 80 miles of high-tension transmission line from the plant to Timmins. The cost is estimated at $3,000,000.

WHEATLEY, ONT.—The installation of an electric lighting and power distribution system, to cost about $35,000, is under consideration.

Electrical Patents

Announced by U. S. Patent Office

(Issued Dec. 5, 1922)

1,437,827. X-RAY DENTAL-FILM PACKAGE; A. F. Sulzer and H. G. Dewey, Rochester, N. Y. App. filed Aug. 16, 1920. Means for holding film in pack.

1,437,886. STARTING INDUCTION MOTORS; J. Bruncken, Cologne-Bickendorf, Germany. App. filed Dec. 2, 1920. Two stators with two armatures upon a common shaft carrying a squirrel-cage winding.

1,437,901. AUTOMOBILE SIGNAL DEVICE; S. O. Martin, St. Louis, Mo. App. filed Feb. 3, 1922.

1,437,961. SECTION INSULATION AND SWITCH; H. E. Conrad, Newark, N. J. App. filed July 15, 1920. Trolley wire sectionalizer for mine service.

1,437,986. STORAGE BATTERY; S. M. Meyer and W. James, Brooklyn, N. Y. App. filed Oct. 27, 1921. Construction of storage batteries to withstand shocks.

1,438,003. ELECTRICAL SWITCH DEVICE; R. Varley, Englewood, N. J. App. filed Nov. 15, 1920. For rectifying current from low-frequency generators.

1,438,065. TROLLEY-LINE SUPPORT; G. D. Slaymaker, Detroit, Mich. App. filed Oct. 1, 1921. Strain plates for overhead wiring system.

1,438,084. ELETRIC BATTERY; R. C. Benner and H. F. French, Fremont, Ohio. App. filed Feb. 12, 1920. Zinc electrode separated from other elements until cell is used.

1,438,085. ELECTRIC BATTERY; R. C. Benner and H. F. French, Fremont, Ohio. App. filed April 15, 1920. Dry cells of deferred-action type.

1,438,086. HIGH-VOLTAGE COPPER-OXIDE DEPOLARIZER; R. C. Benner and H. F. French, Fremont, Ohio. App. filed July 15, 1920. Copper oxide depolarizer batteries.

1,438,106. TELEPHONE SET; F. E. Gallagher, Santa Clara, Cal. App. filed July 19, 1921. Receiver and hook covered with felt to reduce noise.

1,438,107. TELEGRAPH TRANSMITTER ATTACHMENT; C. F. Gruetter, San Francisco, Cal. App. filed Feb. 12, 1921. Spring contacts.

1,438,110. DRY CELL AND PROCESS OF ASSEMBLING THE SAME; C. Hambuechen, New York, N. Y. App. filed March 29, 1922. Protective layer adherent to the inner surface of zinc container.

1,438,121. IMMERSION HEATER; J. F. McCloskey, Wilmington, Del. App. filed Aug. 17, 1921. Exposed element.

(Issued Dec. 12, 1922)

1,438,170. TELEPHONE SYSTEM WITH FLICKERING RECALL; H. D. Currier, Chicago, Ill. App. filed Sept. 19, 1914.

1,438,174. MOTOR CONTROL; G. Fornaca, Turin, Italy. App. filed Jan. 12, 1920. Remote control for automobile starter.

1,438,217. MEANS FOR AND METHOD OF REGULATING THE TRANSMISSION OVER ELECTRIC CIRCUITS; A. B. Clark, Brooklyn, N. Y. App. filed Sept. 10, 1918. Communication system.

1,438,218. MEANS FOR AND METHOD OF REGULATING THE TRANSMISSION OVER ELECTRIC CIRCUITS; A. B. Clark, Brooklyn, N. Y. App. filed Sept. 10, 1918. Four-wire signaling system.

1,438,219. MEANS FOR AND METHOD OF REGULATING THE TRANSMISSION OVER ELECTRIC CIRCUITS; A. B. Clark, Brooklyn, N. Y. App. field Sept. 10, 1918. Communication system.

1,438,220. MEANS FOR AND METHOD OF REGULATING THE TRANSMISSION OVER ELECTRIC CIRCUITS; A. B. Clark, Brooklyn, N. Y. App. filed Sept. 10, 1918. Communication system.

1,438,253. ELECTRIC OVEN; F. W. Moffat, Weston, Ontario, Can. App. filed June 14, 1920. Connections all made outside oven structure.

1,438,270. MEANS FOR REGULATING THE TRANSMISSION OVER FOUR-WIRE CIRCUITS; S. P. Shackleton, New York, N. Y. App. filed Sept. 10, 1918. Communication system.

1,438,290. PROCESS AND APPARATUS FOR WIRELESS TELEGRAPHY AND TELEPHONY; W. E. Beakes, New Orleans, La. App. filed July 1, 1918. Operative length of antenna varied for different wave lengths.

1,438,306. ELECTRICAL SIGN; A. C. Heiny, Flushing, N. Y. App. filed April 20, 1916. For flashing news, telegrams, etc.

1,438,329. METHOD OF FORMING AN AERIAL CONDUIT, AN AERIAL CONDUIT AND AERIAL CABLE RING; H. W. Pleister, Westfield, N. J. App. filed Nov. 4, 1920.

1,438,344. SECTIONAL LIGHTING FURNITURE; A. J. Sweet, Milwaukee, Wis. App. filed Feb. 10, 1919. Fixtures readily altered to meet changes in requirements.

1,438,347. RECEIVING APPARATUS FOR RADIO SIGNALS; R. A. Weagent, Douglas Manor, N. Y. App. filed March 6, 1920. Central control for receiving from several antennas.

1,438,361. ELECTRIC MOTOR; G. B. Coleman, San Francisco, Cal. App. filed Jan. 3, 1921. Variation of speed produced by varying air gap between stator and rotor.

1,438,381. ELECTRIC REVERBERATORY FURNACE; R. M. Keeney, Denver, Col. App. filed Dec. 5, 1919. Electric current passes through automatically maintained shallow bed of material in closed smelting chamber.

1,438,422. METHOD OF MAKING ARMATURES; V. G. Apple, Dayton, Ohio. App. filed May 7, 1918. Rear ends of conducting bars welded together.

1,438,423. ARMATURE; V. G. Apple, Dayton, Ohio. App. filed May 20, 1918. Means of attaching commutator segments to armature conductors.

1,438,445. ELECTRIC HEATER FOR WATER AND OTHER LIQUIDS; G. E. Loubiere, Buenos Aires, Argentina. App. filed Dec. 21, 1921.

1,438,454. BATTERY YERMINAL; H. R. Mitchell, Seattle, Wash. App. filed May 29, 1922. Raveling of insulation adjacent to tapered plug prevented.

1,438,497. MEANS FOR HOLDING ELECTRODES USED IN SOLDERING AND DEPOSITING METALS BY THE ELECTRIC ARC; E. H. Jones, London, England. App. filed Feb. 25, 1920.

1,438,499. SOCKET SUSPENSION MEANS; M. Klein, New York, N. Y. App. filed Nov. 6, 1920. Socket attached to horizontal fiixture provided with flexible joint.

1,438,500. STEREOSCOPIC X-RAY APPARATUS; L. R. McDonald, Montreal, Quebec, Can. App. filed March 3, 1921.

1,438,508. IDENTIFICATION DEVICE; H. F. Waite, New York, N. Y. App. filed Nov. 20, 1920. Finger printing with X-ray machine.

1,438,516. COMBINATION ELECTRICAL HEATER AND COOKER; M. Butcher, Fernie, B. C. App. filed Feb. 20, 1922. Used for either cooking or room heating.

1,438,531. FLASHLIGHT; C. C. Keller, Ysslanti, Mich. App. filed June 18, 1921.

1,438,545. ELECTRIC WELDING; J. B. Murray, and T. E. Murray, Jr., Brooklyn, N. Y. App. filed Oct. 3, 1921. Method of securing good pressure weld over lengthy surface.

1,438,552. DIRECTION SIGNAL FOR AUTOMOBILES; R. H. Quackenbush, Baldwinsville, N. Y. App. filed May 6, 1920.

1,438,554. ELECTRICAL CONNECTOR; M. W. Robertson, Belle Harbor, N. Y. App. filed June 24, 1920. Brush "pigtail" bound and soldered.

1,438,555. ANNUNCIATOR SETTING DEVICE; S. D. Rose, Seattle, Wash. App. filed July 31, 1920.

1,438,557. AUTOMATIC TELEPHONE SYSTEM; F. W. Scharf, Sioux City, Iowa. App. filed Aug. 4, 1913. Trunk pre-selector provides idle trunk line that is maintained in selective condition.

1,438,567. WIRELESS SIGNALING APPARATUS; R. E. Winstanley, Jr., Boston, Mass. App. filed Feb. 1, 1919. Automatic equipment for small boats which dispenses with trained operator.

1,438,576. SIGNAL; H. M. Browne, Washington, D. C. App. filed May 14, 1921. Automobile direction signal.

1,438,602. WAFFLE IRON; H. Krueshеld, Mansfield, Ohio. App. filed July 15, 1920. Electrically heated.

1,438,612. PANTOGRAPH TROLLEY; W. Schaake, Pittsburgh, Pa. App. filed Feb. 15, 1919. Extended and retracted at predetermined speeds.

1,438,616. SPEED-REGULATOR SYSTEM; S. A. Staege, Pittsburgh, Pa. App. filed April 9, 1919. Fly-ball governor maintains constant motor speed.

1,438,621. DETACHABLE CIRCULATING WATER-HEATER UNIT; F. Thornton, Jr., Mansfield, Ohio. App. filed July 19, 1920. Semi-tubular resistor-supporting members.

1,438,624. SYSTEM OF CONTROL; A. D. Webster, Wilkinsburg, Pa. App. filde May 14, 1921. Relay governs operation of circuit breaker that responds to overload conditions.

1,438,635. TEMPERATURE-CONTROLLING SYSTEM; O. A. Colby, Irwin, Pa. App. filed Aug. 18, 1921. Two heating elements connected for either series or parallel operation.

Vol. 80, No. 27 New York, December 30, 1922 *Pages 1425-1480*

Electrical World

Member Audit Bureau of Circulations, Member Associated Business Papers, Inc.
W. H. ONKEN, JR., and HAROLD V. BOZELL, *Editors*

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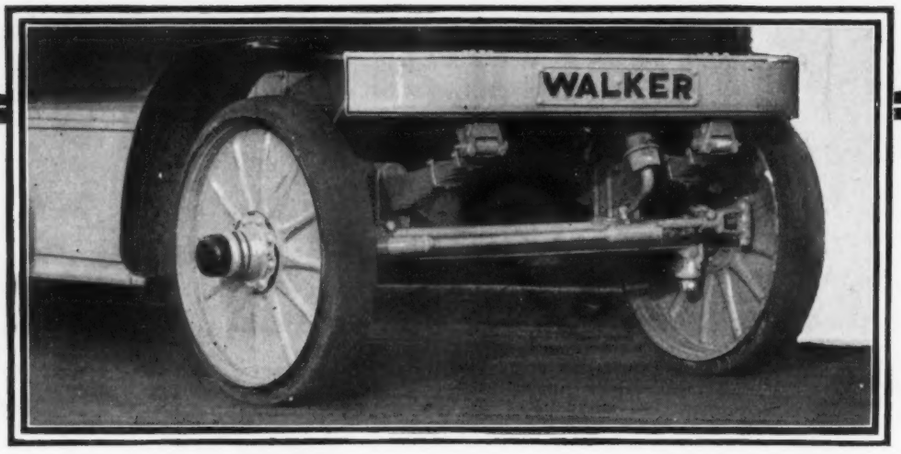


Electric appliances of this type paid two central stations about $2,000,000 in 1922.

The experience of New York and Chicago central stations in building up to a combined gross income of nearly $2,000,000 a year from the sale of off-peak current for charging electric vehicle batteries is suggestive to other electric companies which have devoted much energy to building up day and evening current consumption.

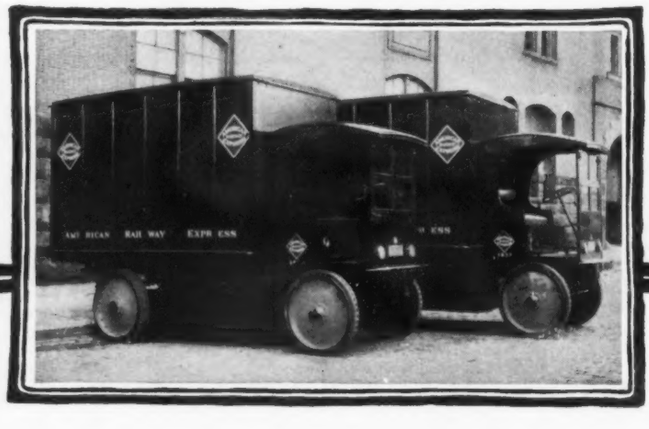
Promoting the wider use of electric trucks is promoting one of the most rapid and most profitable sources of current sales during the hours of your off-peak load.

NOTE! An electric truck of medium size profitably consumes more current than 750 vacuum cleaners, or 650 washing machines, or 200 electric percolators, or 200 60-watt lamps, or 200 toasters, or 150 electric irons.

Load Capacities: ½-1-2-3½-5 tons

WALKER *Electric* TRUCKS
LOWEST TRUCKING COST

WALKER
VEHICLE
COMPANY
CHICAGO
NEW YORK
BOSTON
PHILADELPHIA
BUFFALO



AMERICA'S LEADING MANUFACTURER OF ELECTRIC ROAD TRUCKS

The American Railway Express Company is continually adding the newest model Walker Electrics to its city fleets, replacing horses and gas trucks because of the greater savings the Walkers' make possible.

Printed in popular periodicals to make the Utilities better known by those they serve, this advertisement of our series shows that better living conditions, better business and a profitable, safe investment result when townspeople invest in their own Utility's securities.

The most powerful electric generator known

Pulling rabbits out of a hat is child's play compared with the stunts a man must make the Family Pocketbook perform. But here's one job for it that will actually make it fatter.

The telephone and electric light companies of America can use money to enlarge their service—and they pay well for the money they ask you to invest.

But "yield" is not all you should be interested in, as a careful investor. How about safety of principal?

This, too, is assured—because these companies are regulated by your state public utility commission, which must safeguard their property in the interest of public service.

In addition to this, the stability of these public utilities is assured in the ever growing need for their service—a demand which will put to work over a billion dollars' new capital each year.

Additions to plant must be built. New lines must be extended. Provision must be begun now to serve the millions of new homes which the nation has got to build.

You have an interest in all this. You want your town to develop right. You want the business that cheap and abundant power will bring. You want well-lighted streets. You want the convenience and the safety of telephone service in your own home.

It all comes back to your pocketbook. Put it to work. Invest in some sound telephone or electric light security. Both you and your town will be gainers.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Western Electric Company

Since 1869 makers and distributors of electrical equipment

Number 33 of a series

In providing for Years of Service

why jeopardize the investment with anything less than the best equipment?

The other morning we watched a squirrel working away outside the office window. He was very busy. He scuttled back and forth with unbounded energy, bringing all sorts of squirrel delicacies home to hide in his pantry, convenient to his winter home.

This squirrel looked as though he had just had a tip on the market and was scratching together all his assets in order to take advantage of the opportunity.

As a matter of fact, we know that he has just received a very good tip. He can see ahead for a couple of seasons and he knows that he has to make provision for a change in circumstances. He doesn't put any unsound nuts into his store, either.

Most engineers provide adequate plans ten, twenty years and even longer in advance, and they select equipment on a basis of performance and insured service over an extended period.

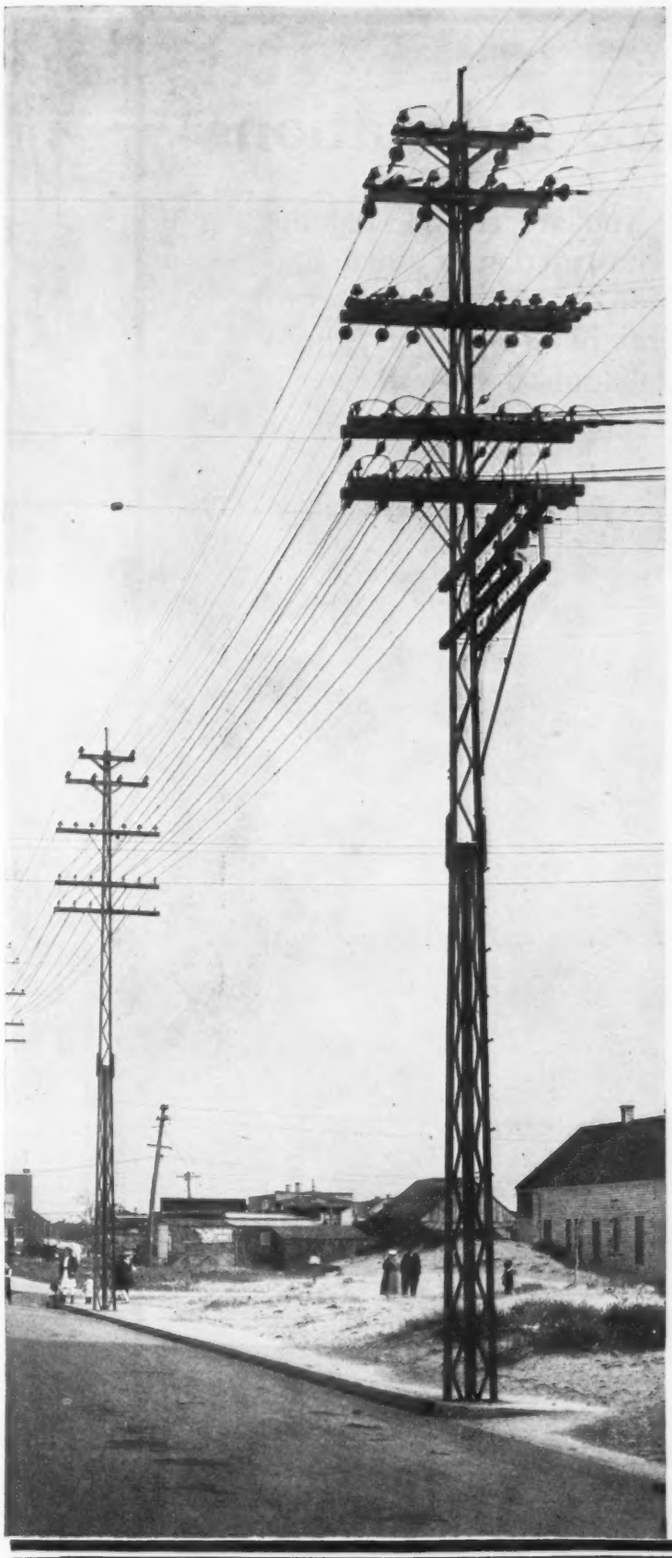
A great many of the most careful utility executives, in laying their metering plans for the future install Duncan Watthour Meters. They are regarded as the soundest investment in service for the future as well as the present.

The reasons for superior, long time service from Duncan Meters are readily demonstrated. We are always glad to point out details of design and construction that make Duncan Meters worth more in continuous satisfactory service. We are especially ready to help the utility man who wishes to make sure that only sound, reliable equipment goes into his store.

DUNCAN ELECTRIC MANUFACTURING CO.,

Lafayette, Ind.

DUNCAN WATTHOUR METERS



Big Bates Poles for Distribution

Heavily loaded distribution lines on city streets present a frequent problem to engineers responsible for overhead line construction. Big poles to carry the load require space that is sometimes difficult to secure. Arrangements for guying these big poles are complicated by lack of space and by existing structures as well as by the right of way which cannot be obstructed.

The Gary Heat, Light, and Water Company maintain an extensive distribution system, parts of which are heavily loaded and along busy public streets. The line shown here is one of these, where the use of Bates Steel Poles has removed the difficulties which usually attend this class of construction.

Notice the pole in the foreground, which is a corner pole in the line and carrying a good size load of feeder cables. This, as well as the rest of the line, is standard Bates construction, a 65-foot pole built up of three one-piece Bates Steel Poles.

Though these are big poles, they do not look cumbersome nor heavy, and they are set into the sidewalk with less obstruction than would be necessary with other poles of sufficient strength to carry the load.

Bates Big Steel Poles are being used in a number of applications where great strength must be provided within limited space for setting and erection. Full data on the applications and cost of Bates Poles will be provided upon request to our nearest district office.

Bates Expanded Steel Truss Co.

208 South La Salle Street, Chicago, U. S. A.

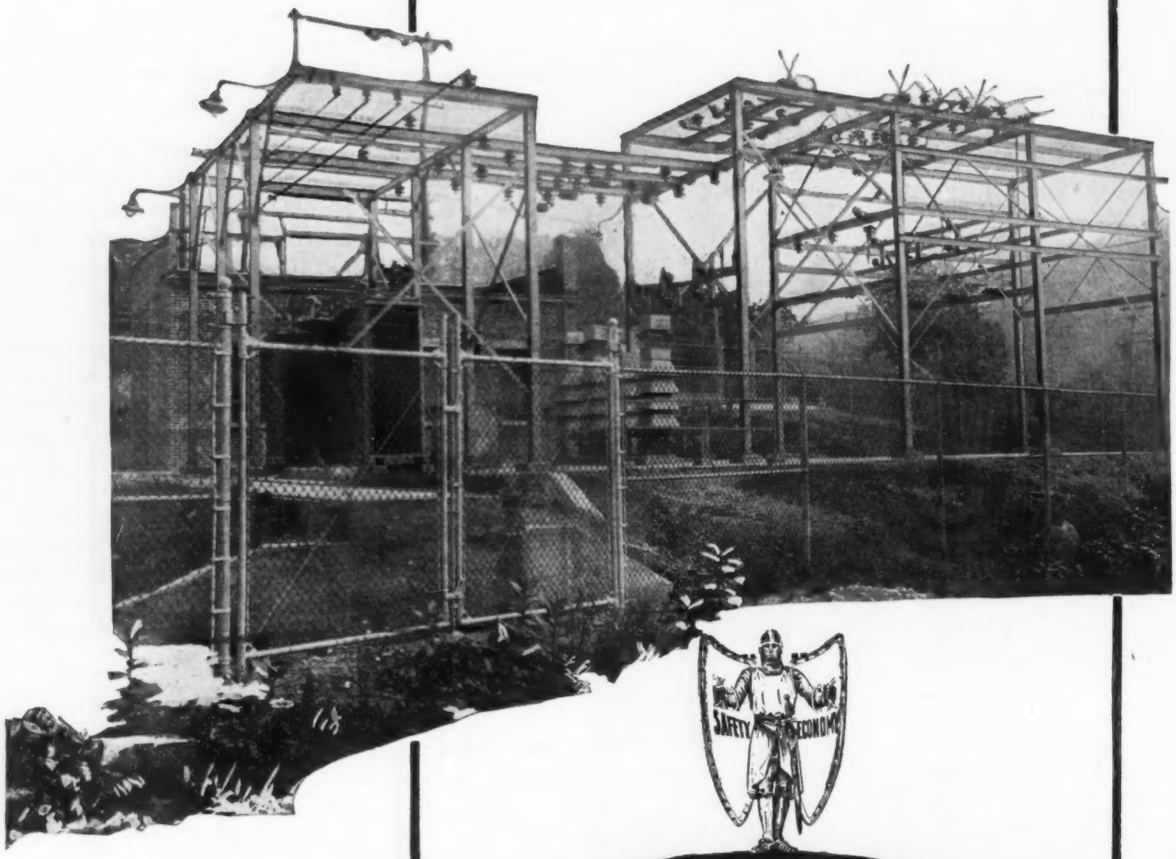
District Offices in All Principal Cities

BATES ONE PIECE EXPANDED STEEL POLES

Elpeco Substations

IF you are considering the construction of a new substation—we shall be glad to submit photos of some Elpeco installations for your consideration.

Our Engineering Department is at your service to cooperate in laying out new work.



ELPEC

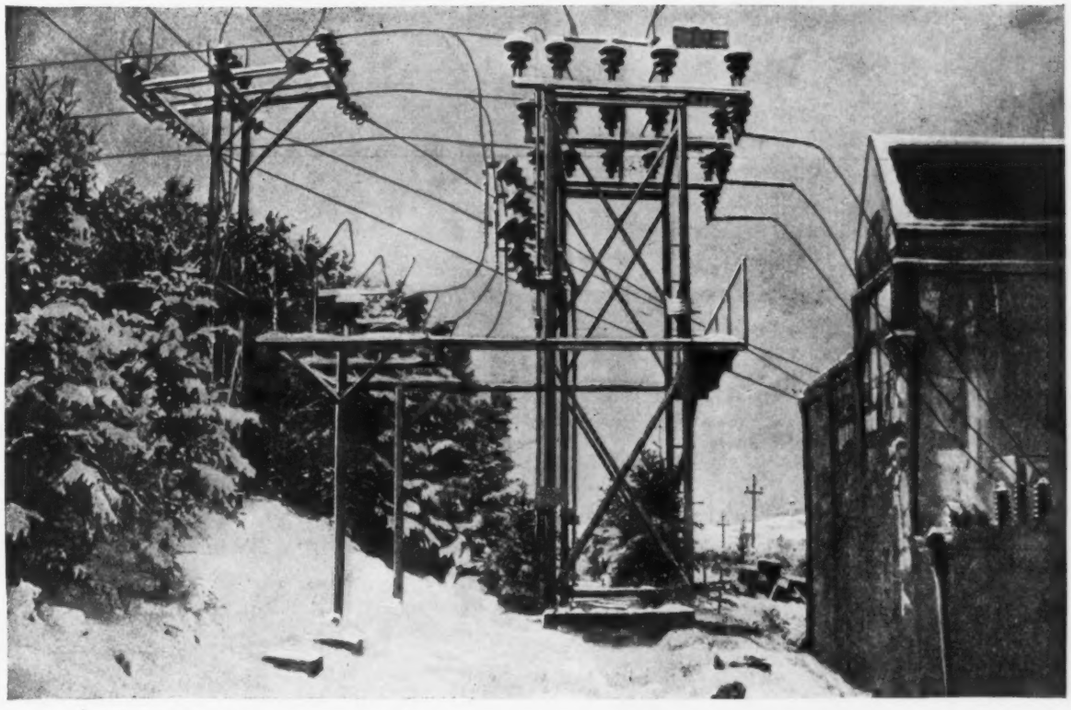
ELECTRIC POWER EQUIPMENT CORPORATION

PHILADELPHIA

HIGH TENSION EQUIPMENT

UNIT TYPE UNIT TYPE UNIT TYPE UNIT TYPE UNIT TYPE UNIT TYPE

How Long Can a Air Break Switch Go Without Re-Greasing?



Unit-Type 50,000/15,000 Volt Steel Tower Substation Giving Service in Norway

Alemite Greasing

HOW often switch bearings need greasing depends upon the design and local conditions. But when they do need greasing it is a difficult matter unless the switch is properly equipped. Delta-Star Switches now have "Alemite" High Pressure Grease Cups—so just use a grease gun. Simple, isn't it?

Ice Breaking

MOST of the trouble with ordinary switches is due to sticking or freezing of the bearing and contacts. Delta-Star Switches also have the "A.R.T." ice breaking blade movement so forceful in its action that it breaks the ice. The combination of this feature with "Alemite" greasing insures satisfaction.

If you haven't our publications you are missing something

DELTA-STAR ELECTRIC CO., 2433-59 Fulton Street, Chicago, Ill.

Manufacturers of High Tension Equipment

New York, N. Y., 25 Broad St.
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Rochester, N. Y., 119 Main St., E.
Syracuse, N. Y., City Bank Bldg.
Buffalo, N. Y., 595 Ellicott Square
Kansas City, Mo., Interstate Bldg.
St. Louis, Mo., Railway Exchange
Salt Lake, Utah, 313 Dooly Bldg.
Toronto, Ont., 67 Yonge St.
Indianapolis, 518 Trac. Term. Bldg.
Seattle, Wash., Hoge Bldg.
Philadelphia, Pa., 1333 Real Estate Trust
Columbus, Ohio, 600 Joyce Realty Bldg.
Minneapolis, Minn., 310 Security Bldg.
Los Angeles, Cal., I. W. Hellman Bldg.
Birmingham, Ala., 827-830 Brown-Mark Bldg.
Pittsburgh, Pa., Union Arcade
Soc. Francaise Ohio Brass & Electric
7 Rue de Tilsitt, Paris, France
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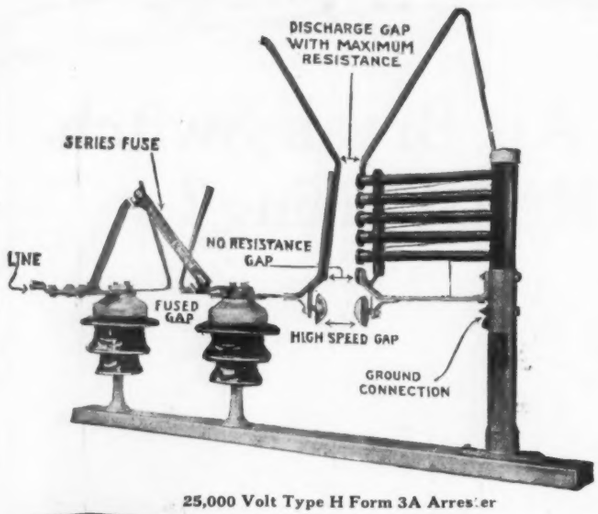
Carrick Wedderspoon & Co.
Christchurch, New Zealand

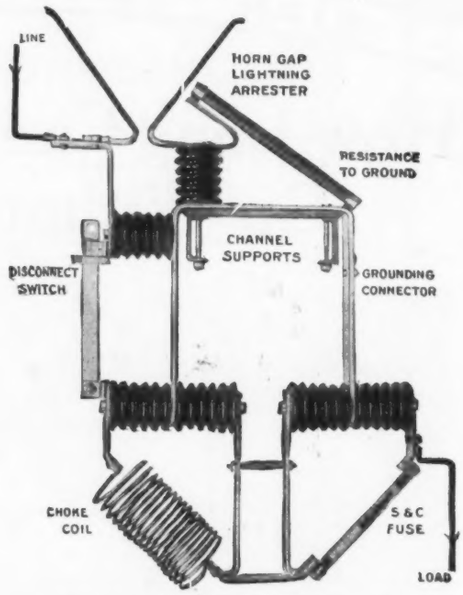
DELTA-STAR

The Standard of Comparison

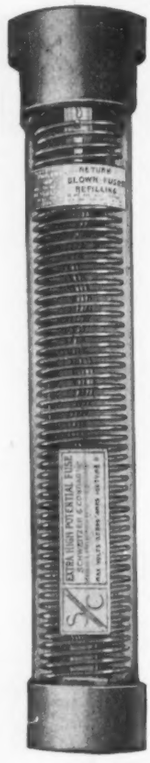
UNIT TYPE INTERCHANGEABLE PARTS



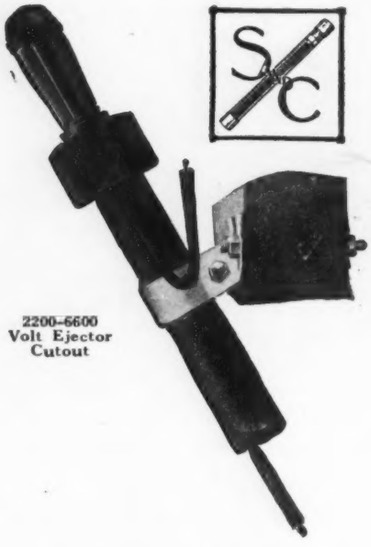
25,000 Volt Type H Form 3A Arrester



Single Pole 15,000 Volt XW Combination



25,000 Volt 100 Ampere S&C Fuse



2200-6600 Volt Ejector Cutout

High Voltage Protective Equipment

Assured protection is a valuable asset. An investment in S&C High Voltage Switching and Protective Equipment represents such protection. The security of such an investment is *firmly* established by years of satisfactory service in the field.

Extra High Voltage Fuses	*Choke Coils*
Lightning Arresters	*Pole Top Switches*
Primary Cutouts	*Bus Bar Supports*
Fuse Mountings	*Outdoor Substations*
Fused Switches	*Rural Service Equipment*
Disconnect Switches	*Voltage Detectors*

"S&C" FUSE

is the correct trade name although it has been referred to and described as "Carbon Tetrachloride," "Tetrachloride," "Pyrene," and "Chemical" Fuse. The Manufacture, Sale and Use are controlled by United States and Foreign Patents, granted and pending. The **S&C FUSE** is manufactured in the United States only by **Schweitzer & Conrad, Inc.**

Write for Bulletin on This Equipment

SCHWEITZER CONRAD, INC.

4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS U.S.A.

New York City, 50 Church St., Room 2070
Buffalo, 950 Ellicott Square Bldg.
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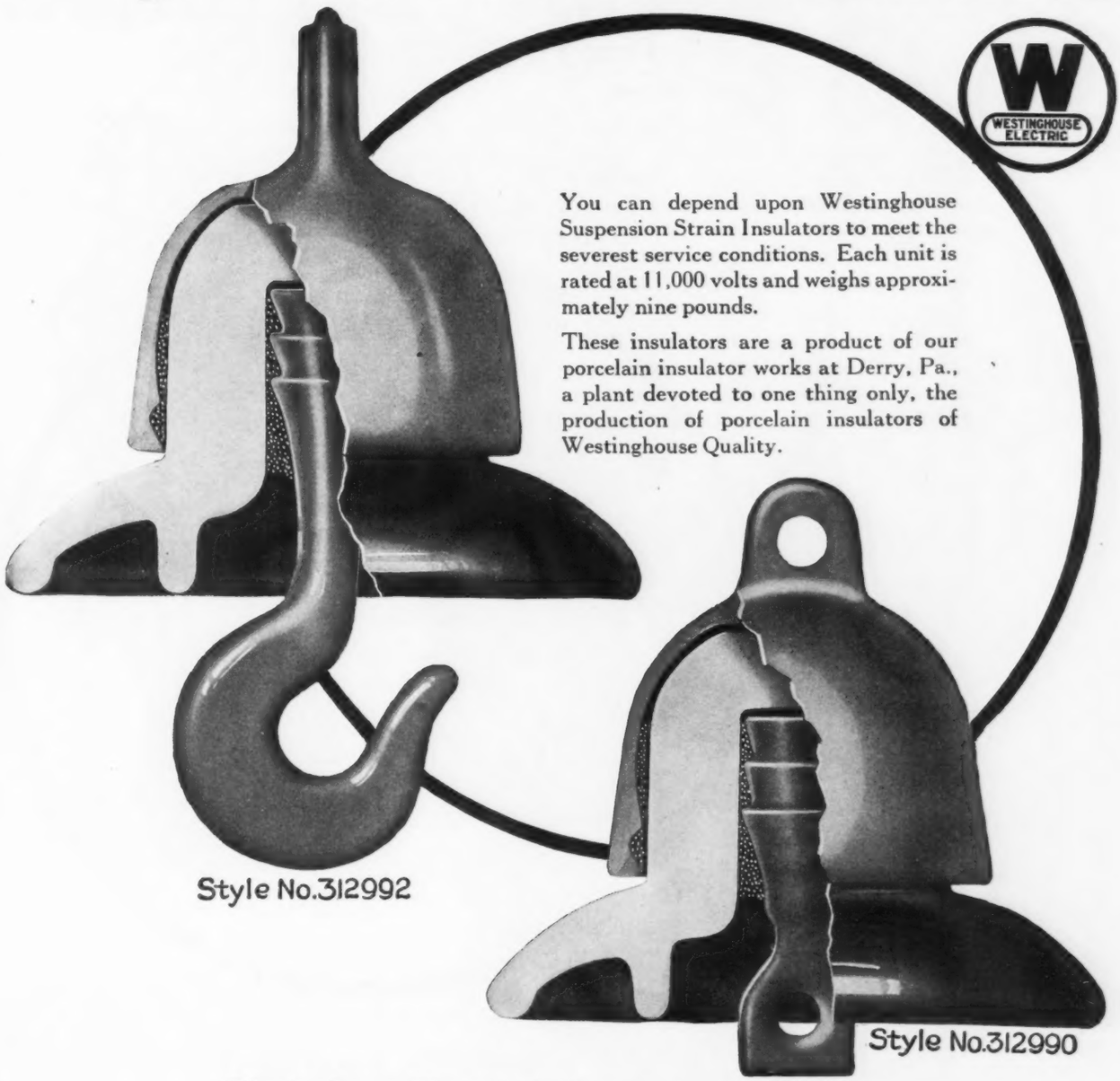
Cleveland, Ohio, 1202 Illuminating Bldg.
Youngstown, Ohio, 109 Wick Ave.
Oakland, Cal., 708 Oakland Bank Bldg.
St. Louis, 1004 Federal Reserve Bank Bldg.
Kansas City, 717 Bryant Bldg.
Omaha, Nebr., 513 Electric Bldg.
Minneapolis, 915 Metropolitan Life Bldg.
Los Angeles, 211 I. W. Hellman Bldg.
Sioux Falls, S. D., 213 W. Ninth St.
Birmingham, Ala., 426 Jefferson County Bank Bldg.
Toronto, Ontario, 24 Adelaide St., East
Winnipeg, Man., 703 Confederation Life Bldg.
Vancouver, 609 Credit Foncier Bldg.
Montreal, 134 Coristine Bldg.

Westinghouse Suspension Strain Insulators



You can depend upon Westinghouse Suspension Strain Insulators to meet the severest service conditions. Each unit is rated at 11,000 volts and weighs approximately nine pounds.

These insulators are a product of our porcelain insulator works at Derry, Pa., a plant devoted to one thing only, the production of porcelain insulators of Westinghouse Quality.

Westinghouse Electric & Manufacturing Company
Agent for Westinghouse High-Voltage Insulator Company
(Successor to Pittsburgh High-Voltage Insulator Company)
General Office and Works, Derry, Pennsylvania

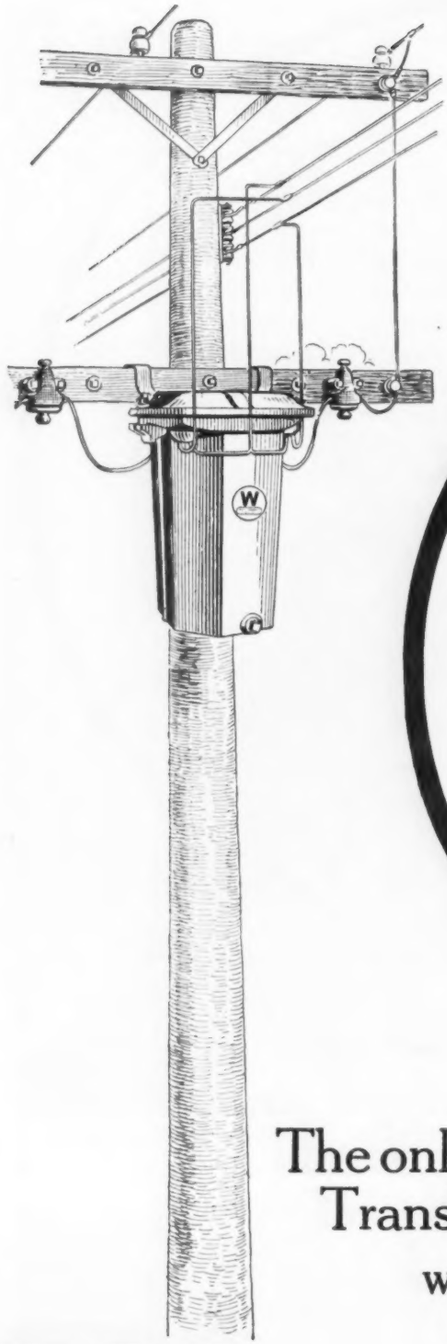
Westinghouse

Westinghouse Steel-Clad Type S

Westinghouse Type S Steel-Clad Transformers are one-third lighter in weight, making them easier to handle and reducing pole strain

but—

when it comes to the coil winding and insulation, they are the same reliable Type S design.



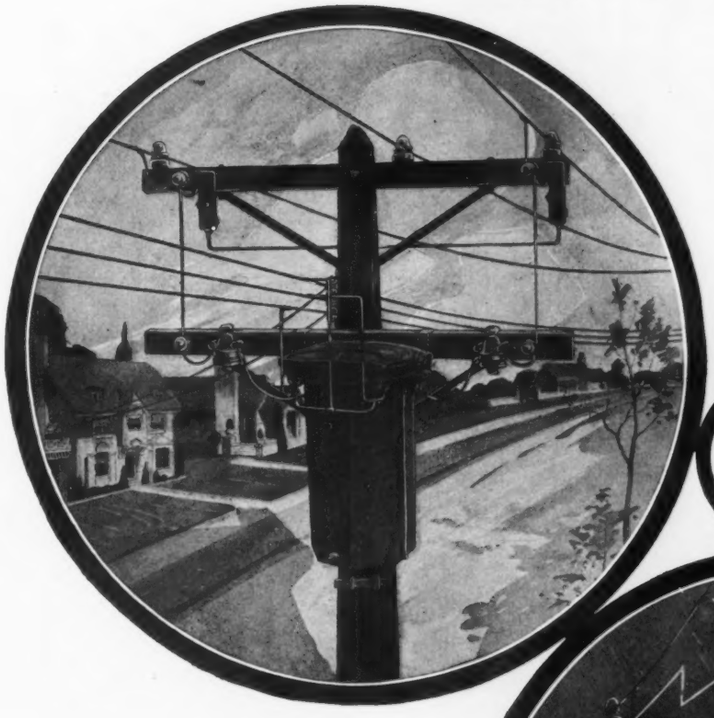
The only way we knew to improve Type S Transformers was to lighten the cases.

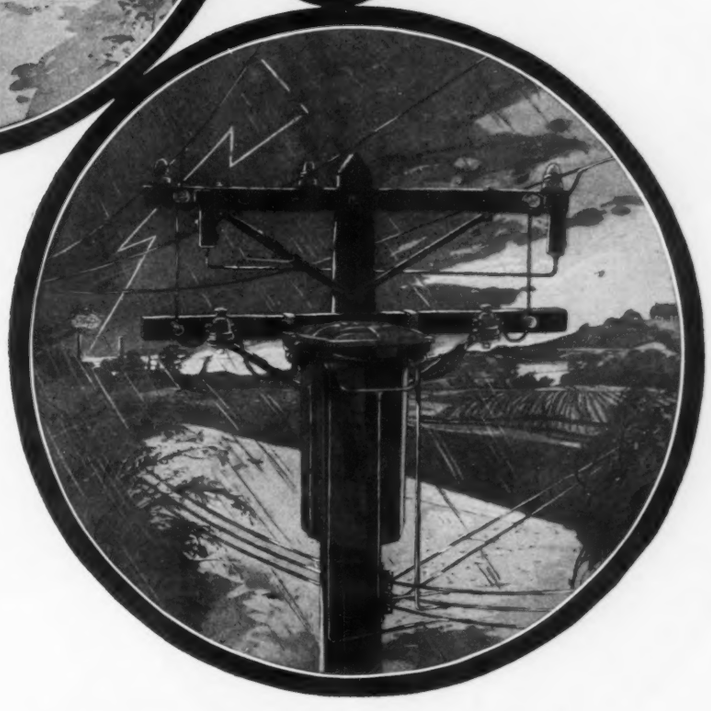
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse

Distribution Transformer

The reliability of Westinghouse Type S Steel-Clad Transformers results from the quality and disposition of the insulation and the method of winding and assembling the coils.



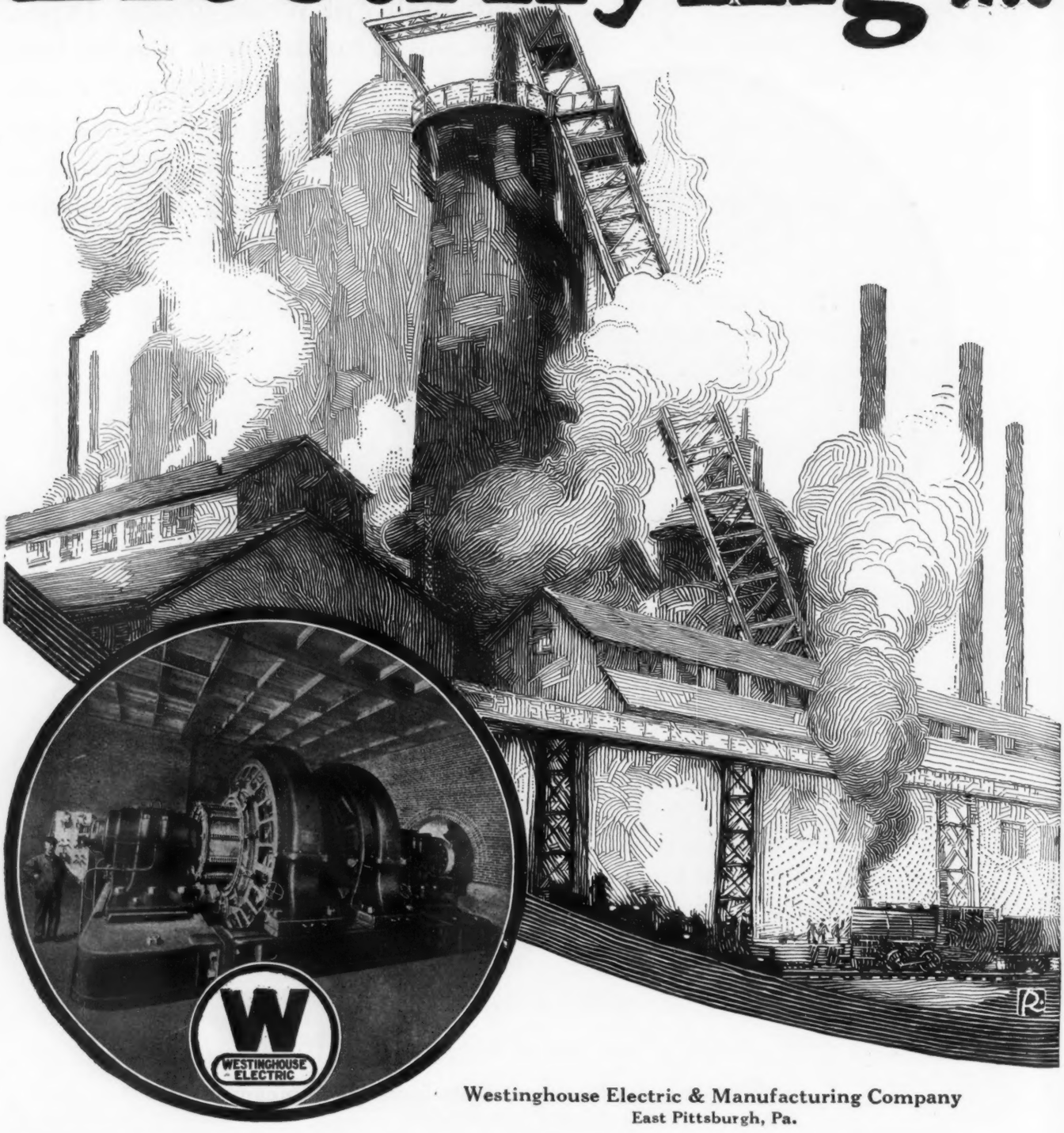


Regardless of weather conditions Westinghouse Steel-clad Type S Distribution Transformers give the same reliable, efficient service.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse

Electrifying *the*



Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

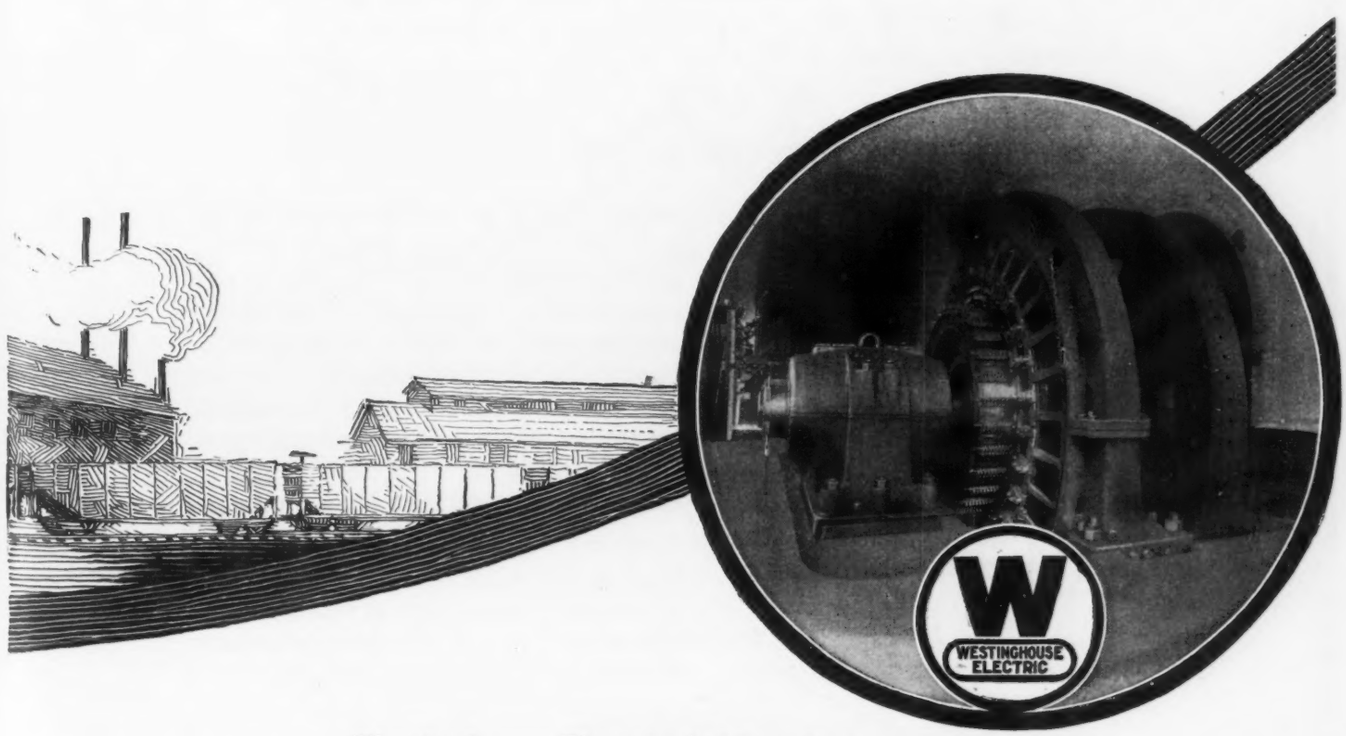
Westinghouse

Steel Industry

No better illustration of the progressiveness of the Westinghouse Company can be found than the splendid part it has played in the electrification of the Steel Industry. Due, in no small part, to the pioneer Work of the Westinghouse Company, the steel industry now utilizes more electrical horsepower than any other industry.

In 1891 the first electric motor was installed in a steel mill. It was a Westinghouse motor. In 1905 the first large rolling mill motor—a fifteen hundred horsepower unit—was installed at the Edgar Thompson Works of the Carnegie Steel Company. It, also, was a Westinghouse motor. In 1906, the first reversing mill motor in the United States was installed by the Illinois Steel Company at South Chicago, Illinois. This again, was a Westinghouse motor. These motors were history-makers in the steel industry.

The development of the reversing mill motor is one of the most remarkable and noteworthy achievements of electrification. These tremendous motors—developing as high as seventeen thousand horsepower and which are almost instantly stopped, started and reversed by the simple turn of a master switch—form the very basis of this great industry. More than seventy per cent of all such motors at present in operation, are Westinghouse.



Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse

Brushes for Ro

For the DC Side—

259

Average Characteristics—

Specific Resistance (ohms per inch cube)	.0018
Carrying Capacity (amps. per sq. inch)	60
Peripheral Speed (ft. per minute) (max. recommended)	6000
Hardness (scleroscope)	55
Strength (lbs. per sq. inch)	2900
Contact Drop	Very High
Coefficient of Friction	Low
Pressure Recommended (lbs. per sq. inch)	2–3

No. 259 is a new electrographitic brush, which combines high carrying capacity, high contact drop, and low friction. It is absolutely non-abrasive. This brush was developed to cover a field of service that was partly covered by Nos. 255 and 257, these grades being limited somewhat in their range of speed. No. 259 is not so hard as Nos. 255 and 257, and consequently operates more quietly, at the same time being applicable to higher speed machines.

We recommend No. 259 especially for the DC side of all types of rotary converters (both 25 and 60 cycles) where the mica is undercut, voltages 80-600, current densities up to 60 amperes per square inch, and peripheral speeds up to 6000 feet per minute. It is also recommended for DC industrial motors and generators with slotted commutators, voltages 80-600, current densities up to 60 amperes, and peripheral speeds up to 6000 feet per minute.

This brush has proved satisfactory on high speed, high current density service where heretofore a more expensive graphite brush has been necessary to secure satisfactory operation.

Write for Catalogue No. 37

NATIONAL CARBON COMPANY, INC.
CLEVELAND, OHIO

tary Converters

For the AC Side—

Ringsdorff ET-10

Average Characteristics—

Specific Resistance (ohms per inch cube)	.0000047
Carrying Capacity (amps. per sq. inch)	115
Peripheral Speed (ft. per minute) (max. recommended)	6000
Hardness (scleroscope)	19
Strength (lbs. per sq. inch)	4900
Contact Drop	Very Low
Coefficient of Friction	Low
Pressure Recommended (lbs. per sq. inch)	2–2½

Ringsdorff ET-10 is a metal graphite brush having a low coefficient of friction. This characteristic, in addition to a low contact drop and the ability to carry high current densities, allows it to operate on brass, bronze, and copper slip rings at speeds up to 6000 feet per minute with minimum dusting and ring wear.

The many successful applications of this brush on converters in all parts of the country have proved its value.

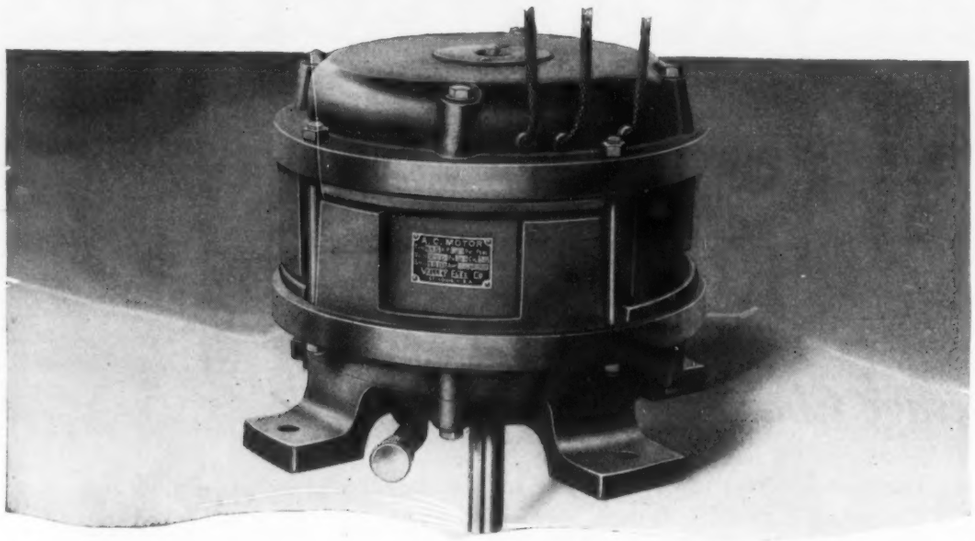
We consider it the best metal graphite brush of high carrying capacity for application on slip rings of rotary converters—DC voltages 80-600, frequencies both 25 and 60—that has been produced to date by any brush manufacturer either in this country or abroad.

▼ ▼ ▼ ▼ ▼ ▼

and Supplement No. 37-A

NATIONAL CARBON COMPANY, INC.
CLEVELAND, OHIO

SKF



Ball Bearings in Vertical Motors
Solve the Lubrication Problem

IT is particularly difficult with step bearings in vertical motors to maintain proper lubrication, especially during the first few seconds of starting. Destructive metal to metal contact often exists and if an oil film fails to form by the time the motor is up to speed, bearing failure quickly follows.

In this vertical motor the lubrication problem is solved by using ball bearings which do not depend upon the maintenance of an oil film for their satisfactory performance. These bearings run practically frictionless in sealed housings, remain cool and show no discernible wear.

An **SKF** marked deep-groove radial ball bearing takes the combined radial and thrust load at one end of the shaft while an **SKF** marked self-aligning ball bearing takes the radial load at the other end of the shaft. This combination makes the design of the motor simple, compact and economical in manufacture.

THE SKAYEF BALL BEARING COMPANY

Supervised by **SKF** INDUSTRIES, INC., 165 Broadway, New York City

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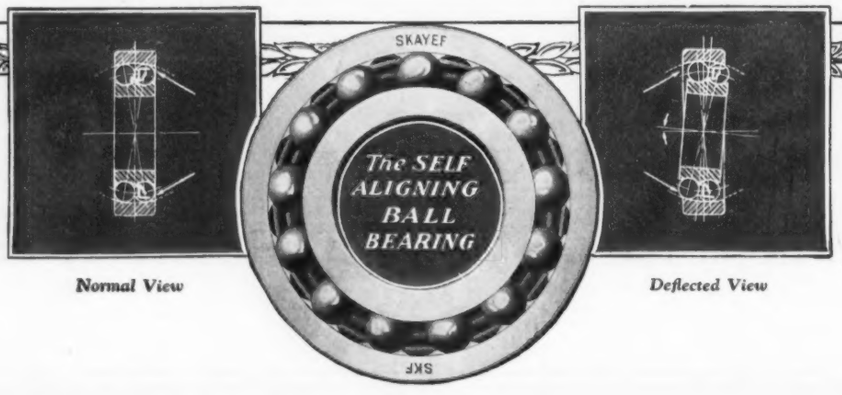

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No. 5

OF A SERIES OF ARTICLES PICTURING THE INFLUENCE OF THE ENGINEER IN THE AFFAIRS OF THE WORLD. PRESENTED BY THE McGRAW-HILL COMPANY, INC., WHOSE PUBLICATIONS HAVE SERVED THE ENGINEER THROUGH HALF A CENTURY OF INDUSTRIAL PROGRESS

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American Machinist

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THE SAFETY OF INDUSTRY

SOME four centuries ago Leonardo da Vinci wrote a treatise on flying in which he endeavored, though not with entire correctness, to describe the mechanism of a bird's flight. It took the intervening centuries to make his theory a fact; and theory is valuable only when it becomes a fact.

¶ It is the irrefutability of basic facts which gives the modern engineer the leadership in many of our greatest and most essential undertakings.

¶ In his hands he holds the safety of this industrial age. Not merely its commercial stability, but the solution, as well, of many of our problems of government, of the revision of ethical principles, the defining of international agreements. From his statistical data will be gleaned much of the means for the social and material reconstruction of the world.

¶ The rise of the engineer as a leader in thought development has been rapid. It has come through proof of his ability to analyze, deduce and conclude; and then to put these findings into action, to express energy in terms of fact.

¶ An impressive proof of his leadership is his being found among the directors of many important financial, commercial and industrial corporations. And when an engineer speaks his associates give heed. For he does not surmise, he states facts; he does not offer conjecture or guesses, he submits statistical evidence.

¶ These newly risen leaders are the producers of facts, the originators of statistics, the developers of proofs. Theirs is the science of truth. They deal with absolutes, yet have no dogmas, for their absolutes are bases for operations, not limitations of practice.

¶ No new truth startles the engineer. He is able to see the combinations of circumstance which lead to the one and only possible conclusion which the new truth proclaims. The engineer gives the safety of certainty to industry.

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This motor has attracted exceedingly lively attention from motor users who need machines that will endure hard service with little attention.

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L-A Motors

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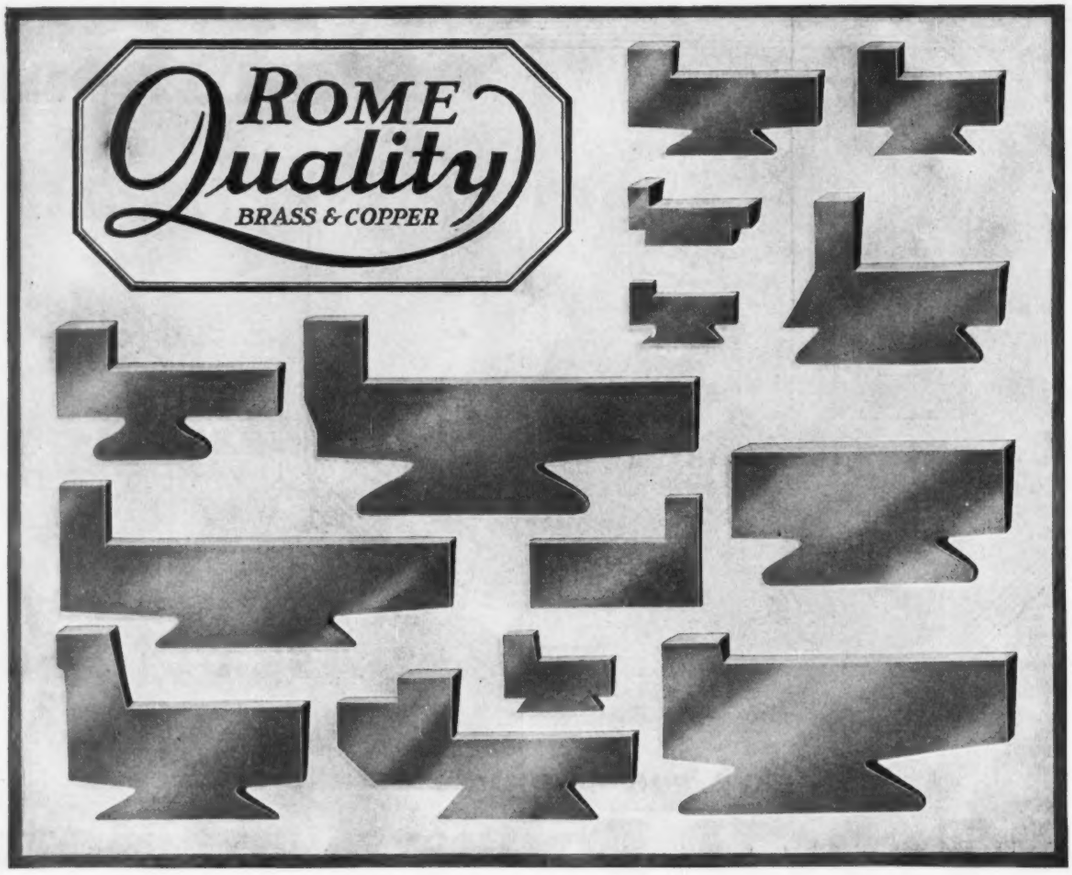
Watson Motors



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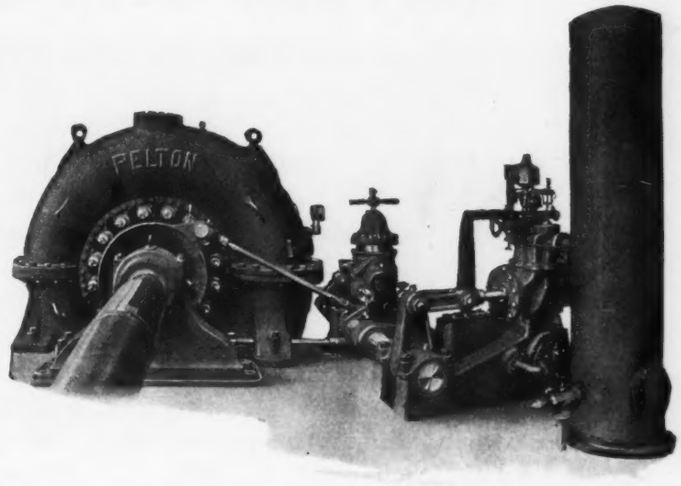
PELTON

Around the World With Pelton



CHAPTER VI.

CHILE

Chile possesses abundant potential waterpower, and the limited local supply of fuel makes its development of particular importance to the welfare of the entire nation. There are a number of important Pelton installations, the largest being the Maitenes plant, part of whose output supplies the pioneer railroad electrification in the country, comprising 144 miles of heavy traffic line between Valparaiso and Santiago.

The plant comprises three Pelton turbines, each with a maximum capacity of 11,500 HP. under a head of 600 feet. A shop assembly of one of these turbines is shown above. They are typical of the large capacity horizontal single overhung reaction turbine as developed by the Pelton Company, and are among the highest-head units of this type.

Among the advantages of this type of construction is the ease with which access may be obtained by simply removing the draft elbow, without dismantling either generator, shaft, or bearings. The saving in time and labor when replacing worn parts is particularly important for installations using silt-laden water.

Hydraulic balance of the runner is obtained by providing wearing rings at a point as close to the shaft axis as the discharge diameter of the runner will permit. Provision is made so that the degree of wear of the renewable clearance rings may be inspected without taking down the turbine.

(Chapter VII, which will appear January 27, will discuss British Columbia)

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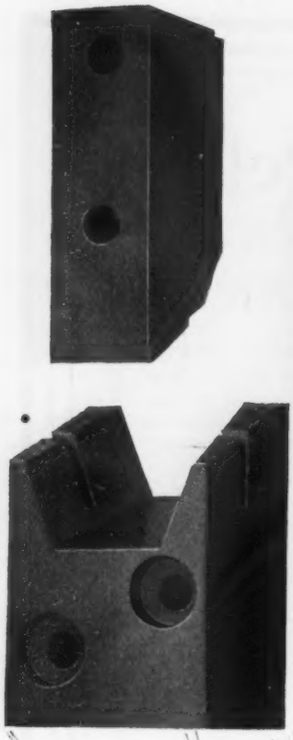

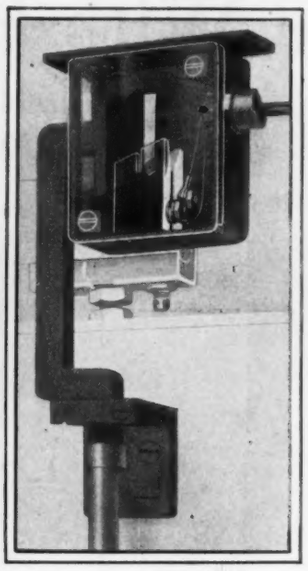

Safeguarding Elevator Service

Moral obligation to safeguard elevator service with interlocking electrical switches, is now well recognized. In the development of any such system, every precaution must be taken that the device function perfectly with minimum care or attention, under practically all conditions.

For the switch lock plates, the vital part of their "ES" Positive Electro-Mechanical Interlock, the Elevator Supplies Company, Inc., of Hoboken, N. J., required a material which would (1) possess high dielectric and mechanical strength, (2) present a hard, impervious surface, highly polished, (3) remain oil and moisture-proof, and (4) be capable of economical molding in the special shapes desired.

They selected Condensite, a phenolic condensation product, which like Bakelite and Redmanol, is a non-hygroscopic material, chemically inert, and mechanically and dielectrically strong — dependable. Molding these pieces procured increased production of known and uniform quality with all tooling or fitting in final assembly eliminated.

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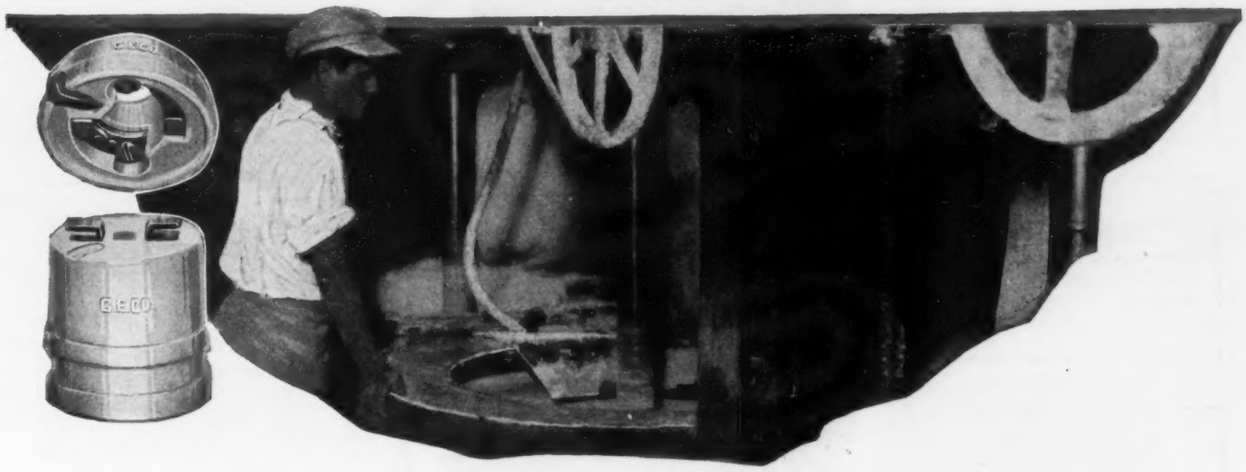

Porcelain Sockets

G-E "snap-catch" porcelain sockets are easily installed due to the absence of screws. The body has two bayonet hooks which engage two flexible phosphor bronze contacts in the cap, locking securely but permitting easy disassembly without disturbing wiring or turning off current. All types of body (pull, key, push button and keyless) are interchangeable with all types of "snap catch" caps and bases.

Economical assembly—simple construction—safety and dependability—all you could ask of a socket.

G-E Threaded Catch Sockets

Sturdily built sockets that will easily support the weight of any reflector now manufactured and resist sidewise leverage and sharp blows. Cap cannot pull loose from shell and no amount of vibration will loosen threaded ring when properly installed. Threaded ring, knurled to provide finger grip, securely holds cap and shell together. Two lugs in the cap fit in any pair of eight slots in the shell effectually preventing any rotation between the cap and shell. The usual types of caps and interiors are available—with the exclusive G-E swivel locking feature, if desired.

G-E Renewable Fuses

First quality fibre tubes assure resistance to the pressure of short-circuit blowouts.

Metal parts are carefully gauged and machined for maximum strength, perfect fit and alignment; special treatment prevents engaging parts from "freezing."

Ferrules of knife blade type have knurled finger grips. In the ferrule type, notched anchor plates are threaded into the ferrules, insuring positive alignment and easy reloading. Vents around threads give positive ventilation.

For economy, use renewable fuses only for circuits where variable loads cause frequent blowouts.

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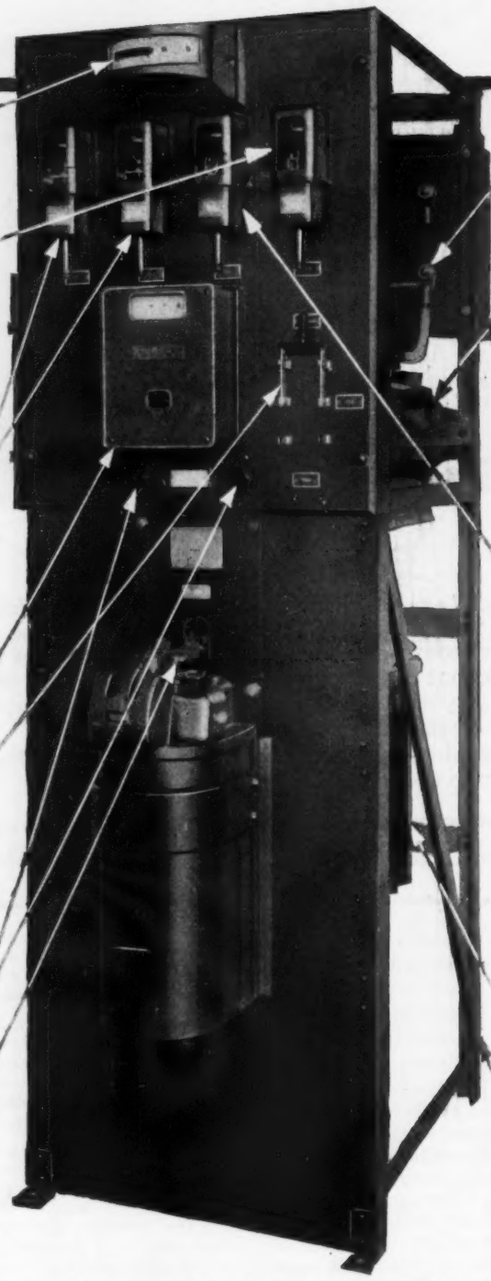
Automatic reclosing equipment for a-c. circuits



Ammeter

Reclosing Relay
Provides definite time interval between opening and reclosing of breaker.

Overload Relays
Open oil circuit breaker on overload.

Watthour Meter

Control Power Switch
In upper position, allows breaker to reclose automatically.
In lower position, opens breaker and suspends automatic reclosing feature.

Indicating Lamps

Motor Mechanism for Operating Oil Circuit Breaker

Disconnect Switch

Current Transformer

Notching Relay
Function:
Suspends automatic reclosing feature, if the breaker is opened three consecutive times, providing the time interval between each opening is less than a predetermined value.
Operation:
The first opening of the breaker causes the relay to notch one step on the ratchet mechanism, but the relay contacts are not opened.
The second opening of the breaker (within a predetermined time) causes the relay to notch the second step on the ratchet mechanism, but the relay contacts are not opened.
The third opening of the breaker (within the same predetermined time) causes the relay to notch the third step on the ratchet mechanism. The contacts of the relay open immediately and remain locked in this position.
If, on the first or second step of the notching relay, the breaker had remained closed, the relay would have returned to its original position. Subsequent openings of the breaker would then start a fresh sequence of operations of the relay and breaker.

Oil Circuit Breaker

Self-supporting Framework

Shipped completely wired and assembled

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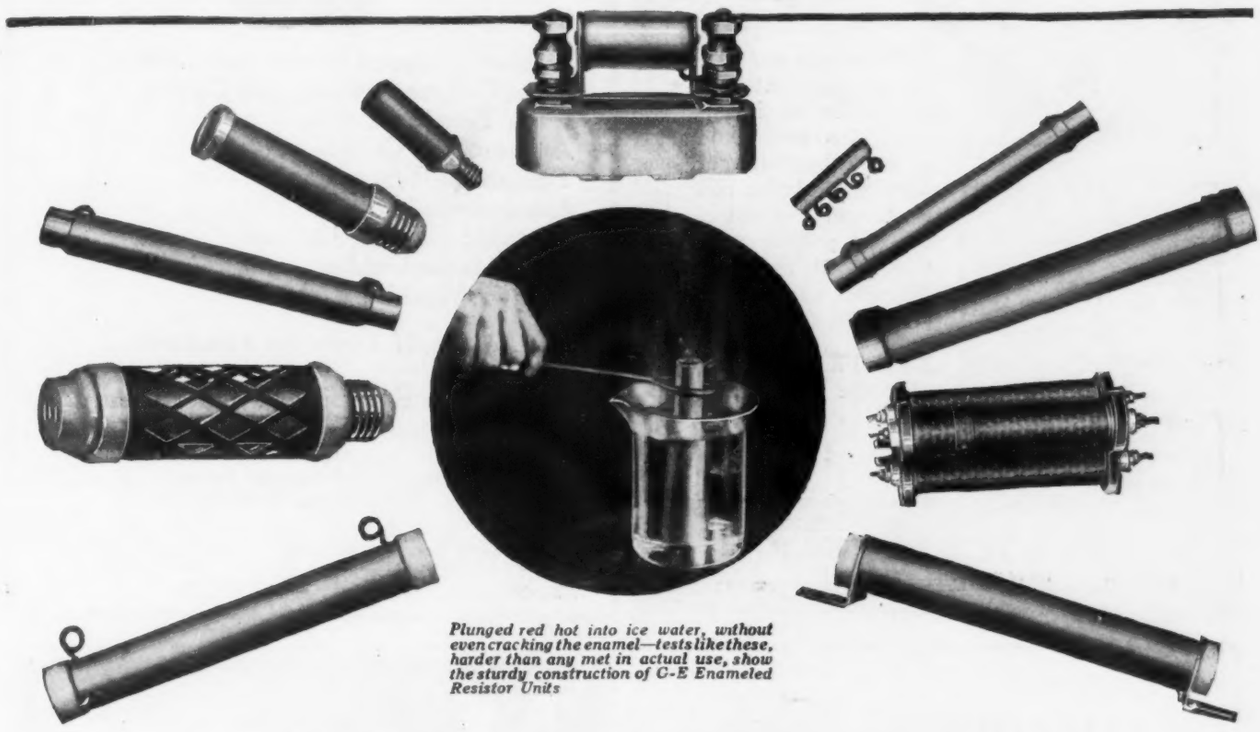
Resistor Units, to give dependable and economical performance wherever used, must resist moisture and withstand extreme changes in temperature



Plunged red hot into ice water, without even cracking the enamel—tests like these, harder than any met in actual use, show the sturdy construction of G-E Enameled Resistor Units

G-E Resistors give unfailing service in many and various applications

G-E Blue-Enameled Resistor Units are used extensively in connection with railway and fire alarm signals, locomotive headlights, telephone circuits, magnets, laboratory and measuring instruments, rheostats, panels, and small motors.

The General Electric Company can furnish these units in practically any variety that may be required, and in colors other than the standard blue.

G-E Enameled Resistor Units have a mechanically strong, high-heat resisting silicate compound body which will withstand all extreme temperature fluctuations without cracking, weakening or in any way being injured.

The resistance winding is protected by a moisture-proof vitreous enamel and the entire surface of the tube is available for dissipation of heat.

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KERITE remains long after the price is forgotten.

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You can check up our entire list of used motors, as shown in our Bargain sheet, with the corresponding prices of new motors—you will find our prices from 30 to 50 per cent. lower. Write us your wants today.

220 Volt D. C. Motors

Hp.			Speed
1	1	G.E., type RC, interp'le	1700
1	1	Westinghouse	1650
2	1	Western Elec.	1300
1	1	G. E., type CQ	1275
1	1	Allis-Chalmers, type K	1200
4	1	G. E., type RC, comp., interpole	1150
1	1	Northern	1150
1	1	Emerson, 6-pole, comp.	1100
1	1	Fairbanks-Morse	1050
1	1	Browning	975
2	1	Fairbanks-Morse, MP, comp.	800
1	1	Peerless, interpole, variable speed	440-900
1	1½	Crocker-Wheeler, form L, comp.	1175
1	1½	Watson, comp.	900
2	1½	G. E., RC, interpole	850
2	2	Gen. Elec., type CQ	2300
1	2	Westinghouse, type S.	2200
1	2	G. E., RC, interpole	1700
1	2	G. E. type CQ	1650
1	2	Westinghouse	1200
3	2	Allis-Chalmers type K.	1200
1	2	Crocker-Wheeler, form L comp.	1200
2	2	G. E., type RC, interple	1150
1	2	G. E., type CE	1100
2	3	Peerless, MP.	1880
2	3	G.E., typeCVC, interp.	1800
2	3	G. E, type RC, interpole	1700
5	3	G. E., type RC, new, comp.	1700
1	3	G. E. type CQ	1100
1	3	Crocker-Wheeler, form L	1050
1	3	Allis-Chalmers, type K	1025
2	3	G. E., type RC, new, interpole	850
4	3	Gen. Elec., type RF-9, shunt, interpole, adjustable speed	450-1350

220 Volt D. C. Motors

Hp.			Speed
1	4	Fairbanks-Morse	1500
1	4	G. E., type RLC shunt, interpole, variable speed with comp. starter	500-1500
1	5	Watson	1750
2	5	Peerless, comp.	1740
1	5	G.E., type CVC, interp.	1650
1	5	Westinghouse	1600
1	5	Westinghouse, MP, type S.	1400
2	5	Peerless	1170
1	5	G. E., type RC, interpole (50°)	1150
4	5	G. E., type CQ	1100
1	5	G. E., type CVC, interpole	1100
2	5	Allis-Chalmers, type K	1050
1	5	Crocker-Wheeler, form L	960
1	5	Northern	800
1	5	Peerless, comp.	725
3	5	G. E., type LC, shunt, interpole, variable speed	475-1425
2	5	Gen. Elec., type RF, interpole, adjustable speed with reversible drum type controller	450-1350
1	5	Northern, back-gd.	850-158
1	6	Westinghouse, type S.	1465
1	6	Fairbanks-Morse, comp.	1175
1	7½	G. E., type RC (50°), interpole	1700
5	7½	Westinghouse, type SK, interpole	1700
1	7½	G. E., MP, type CQ	1200
6	7½	Gen. Elec., type RC, interpole	1150
2	7½	G. E., MP, type CE	875
6	7½	Northern	850
1	7½	Westinghouse, type SK, interpole	850
5	7½	G. E., type LC, shunt, interpole, variable speed	500-1000

220 Volt D. C. Motors

Hp.			Speed
3	7½	Electro-Dynamic, frame 58, shunt, interpole, variable speed	450-1350
1	10	Browning	1700
1	10	G. E., type RC, interpole	1700
1	10	Westinghouse, type S.	1325
1	10	G. E., type CVC, intple.	1250
1	10	Fairbanks-Morse	1200
1	10	G. E., type CQ	1200
1	10	Ft. Wayne, MP, type EF	875
3	10	Westghse., SK, interpole	850
1	10	Westghse, type SK, interpole, variable speed	850-1700
6	10	Northern, MP, type B, comp.	750
1	10	Westghse., type SK, comp., interpole	725
1	10	G. E., comp., interpole, variable speed	625-1250

We have just received some large shipments of 220-volt, direct current motors in capacity from 10 hp. up to and including 50 hp.—send for our January Bargain Sheet showing the prices.

J. L. HEMPHILL & CO. Inc.

ELECTRICAL ENGINEERS AND EQUIPMENT

1118-1120 Clinton Street, Hoboken, N. J.

A. C. MOTORS

3-Ph., 60-Cy.

No.	Hp.	Rpm.	Volts	Make
1	250	900	2200/550	Wstg.C.W.sl.rg.
2	200	900	220/440	G. E., L
1	200	720	220/440	Cr. Wh., sl. rg.
2	200	600	2200	Cr. Wh., sl. rg.
1	100	900	220/440	Westg., sl. rg.
1	100	600	2200	Westg., F, sl. rg.
2	100	720	220/440	G. E., K
1	75	900	220/440	Cr. Wh., sq. cg
1	75	900	220/440	Allis-Chal., ANY
1	75	720	220/440	G. E., K
1	75	600	440	G.E. K.
3	50	900	220/440	Cr.-Wh. & G. E.
1	50	720	440	G. E., sl. rg.
2	35	900	220/440	G. E., sq. cage
1	30	900	220/440	Westg., MS
1	30	1800	220/440	Westg., CW
1	25	1200	220/440	West., CS
1	25	1200	220/440	G. E. K.
1	25	900	220/440	Cr.-Wh.
1	25	600	220/440	G. E.
1	10	1200	220/440	G. E., K. T.
6	2	1800	220	G. E. & West.

2-Phase Motors on request

A. C. Generators

No.	Kw.	Rpm.	Volts	Make
1	100	900	220/440/600	Cr.-Wh.

D.C. Motors, 230-Volt

No.	Hp.	Rpm.	Make
1	250	500	G. E.
4	50	1250	Allis-Chal.
1	50	700	West.
1	50	1075/230	G. E. RC
1	35	875	West.
1	25	1300	Sprague
4	25	600/1200	Allis-Chal.
1	15	1250	Allis-Chal.
1	10	1200	Allis-Chal.
5	10	275/1575	Allis-Chal.

D.C. Motors, 125-Volt

3	20	650	Allis-Chal.
1	15	775	SK. West.
?	7½	1100	G. E.
1	5	700	Diehl
3	3	1100	G. E.
2	3	1700	G. E.

D.C. Generators, 250-Volt

1	200	575	G. E.
1	100	675	G. E.
1	50	600	West.
1	30	1000	West.
2	15	900	Allis-Chal.

Turbo Generators

1—625-kva., 3600 r.p.m., 220/440-v., 60-cy. Gen. Elec. condensing bleeder type with direct connected exciter, excellent condition.
1—187-kva. Westg. non-cond., 2- or 3-ph., 220-440-v., 3600 r.p.m., in operation about 2 yrs.
1—150-kw., 900 r.p.m., 125/250-v., 3-wire De Laval Turbine Set.

D. C. Generators, 125-Volt

5, 10, 20, 25, 40, 50 Kw.

Engine Generator Sets

1—200-kw., 125/250-v., Gen. Elec. 3-wire, 200-rev. gen., 15 and 26 x 17 McIntosh & Seymour tand. cpd. engine.
1—200-kw., 250-v., Gen. connected to Allis-Chal., 18 x 36 right-hand Corliss Engine.
1—150-kva., Cr.-Wh., 220/440-v., 3-ph., 60-cy. Skinner tand. cpd. engine set.
1—125-kva., G. E. A.T.B., 2200/220 connected to Skinner 11 x 18½ x 16 Engine, complete.
1—100-kw., 125- or 250-v., 2-wire, D.C. Westinghouse, R.H. gen. conn. to Harrisburg std. tand. cpd., 11 x 18 x 13 engine, 275 r.p.m., complete.
1—100-kw., General Electric, 250-v., 260 r.p.m. gen., with Ball 13 x 16 non-condensing Eng.
1—50-kw., 125-v. Westghse., R.H., gen. con- r.p.m., compl'te with swbd. & steam separator.

Motor Generator Sets

nected to Harrisburg 13 x 12 std. engine, 300
300-kw., 720-rev., 125/250-v., 3-unit set consisting of (2) 150-kw., 125-v., D.C., G. E. gen. (1) 450-hp., 440/2300-v. motor.
200-kw., 600-rev., 250-v., Gen. Elec Gen., 350-hp., 440/2300-v. syn.
100-kw., 250-v. Gen. Elec. Gen., 720 r.p.m., 220/440-v. syn. motor.
50-kw., 720-rev., 250-v. West. Gen., 75-hp., 220/440-v. motor.
10-20-25-40-kw., 125-v. Exciter Sets.

TIFFANY ELECTRIC COMPANY INC

POWER EQUIPMENT ENGINEERS

OFFICE AND FACTORY 131-143 HOWELL ST. JERSEY CITY, N.J.

Telephone
Cortlandt 4204 (New York)
Bergen 7450 (Jersey City)

Telephone
Cortlandt 4204 (New York)
Bergen 7450 (Jersey City)

MOTORS—GENERATORS

Immediate Shipment

MOTOR-GENERATOR SETS

Gen. 500-kw., 250-volt, 450-r.p.m. Gen. Elec., comp. wd., int'pole
Motor, 900-hp., 2300-volt, 450-r.p.m., 3-phase, 60-cycle synchron.

Note—Two of the above sets in stock.

(Each complete with starter, rheostat, etc.)

Gen. 250-kw., 250-volt, 900-r.p.m. Gen. Elec., comp. wd.
Motor, 375-hp., 2300-volt, 900-r.p.m., 3-ph., 60-cy. Gen. Elec., syn.

Gen. 250-kw., 250-volt, 720-r.p.m. Gen. Elec., interpole.
Motor, 375-hp., 2300-volt, 720-r.p.m., 3-ph., 60-cy. Gen. Elec., synchron, with direct connected exciter.

Gen. 185-kw., 550-volt. 600-r.p.m. Gen. Elec. "CLB", 6-pole.
Motor, 300-hp., 2300-volt, 600-r.p.m., 3-ph., 60-cy. Gen. Elec., "ATI" syn.

Gen. 50-kw., 250-volt, 900-r.p.m., comp. wd. "RC" Gen. Elec.
Motor, 75-hp., 440-volt, 900-r.p.m. Gen. Elec., 3-ph., 60-cy. "KT"

Gen. 50-kw., 125-volt, 900-r.p.m., comp. wd. Gen. Elec., "DLC"
Motor, 75-hp., 440/220-volt, 900-r.p.m., 3-ph., 60-cy. Gen. Elec. "KT"

Gen. 15-kw., 250-volt, 1140-r.p.m., comp. wd. Cr-Wh., "CCD"
Motor, 25-hp., 440/220-volt, 1140-r.p.m., 3-ph., 60-cy., sq. cage

The above is a partia list; quotations covering other machines upon request

ROTARY CONVERTERS

Stock Nos. 1413, 1414. Two Practically New, 300-kw., 250-volt, 1200-r.p.m., 3-phase, 60-cycle, Allis-Chalmers, interpole, each complete with Field Rheostat, end play and speed limit devices, and each with three 125-kva., 13,200-volt, primary (also 2300-volt, primary), single phase, 60-cycle transformers and A.C. and D.C. Switch Board Panels.

60-CYCLE MOTORS

Stk. No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy*	*Make and Type*
608	500	2200	600	3	60	G. E., "M", slip ring, 3-bearing
Cons.	400	440	450	3	60	Westghse., "CW", slip ring, 2-bear.
Cons.	250	2200	900	3	60	Westghse., slip ring, "CW", 3-bearing
Cons.	250	550	900	3	60	Wes ghse., slip ring, "CW", 3-bear.
6321	60	440/220	600	3	60	G. E., "M", slip ring.
1389	50	550	860	3	60	Westinghouse, "CCL", sq. cage
1387	50	550	1160	3	60	G. E., "KT," sq. cage
1388	40	550	1200	3	60	G. E., "KT", sq. cage
826	25	440/220	1200	3	60	Westghse., "CCL", sq. cage
1239	22	440/220	1200	3	60	G. E., 'ITC", inter. duty
1025	10	220	1200	2	60	Allis-Chal., sq. cage
1273	10	440/220	1200	3	60	G. E., "KT", sq. cage
6721	7½	220	1200	2	60	G. E., "KT", sq. cage
(5)	6	440	1800	3	60	G. E., 'KT", sq. cage (mult. speed) 600/900/1200/1800

The above is a partial list; quotations covering other machines upon request.

25-CYCLE MOTORS

Stk. No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
806	300	440	500	3	25	G. E., "M", slip ring, 3-brg.
1354	57	440/220	750	3	25	Westghse., sq. cage
822	40	440/220	750	3	25	Burks, sq. cage
1342	35	440/220	750	3	25	G. E., "K", sq. cage
1353	35	440/220	750	3	25	G. E., "K", sq. cage
1357	25	440/220	750	3	25	Westghse., slip ring
7231	20	440/220	750	3	25	G. E., 'M", slip ring
8231	20	440/220	750	3	25	G. E., "M", slip ring
9231	20	440/220	750	3	25	G. E., "M", slip ring
1344	20	440/220	750	3	25	Westghse., sq. cage
0331	20	440/220	750	3	25	G. E., "M", slip ring
1451	20	440/220	750	3	25	Westghse., "CX", sq. cage
1240	10	440/220	750	3	25	G. E., "MT", slip ring
835	10	440/220	750	3	25	Burke, "EM", sq. cage
1315	10	440/220	750	3	25	Westghse., sq. cage
1339	10	440/220	750	3	25	G. E., "KT", sq. cage
1340	10	440/220	750	3	25	Westghse., sq. cage

25-CYCLE MOTORS—Continued

Stk. No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
1352	10	440/220	750	3	25	G. E., "KT", sq. cage
1358	10	440/220	750	3	25	Allis-Chal., sq. cage
1337	7½	440/220	750	3	25	G. E., "KT", sq. cage
1341	7½	440/220	750	3	25	G. E., "KT", sq. cage
1359	7½	440/220	750	3	25	G. E., "KT", sq. cage
836	7½	440/220	750	3	25	Burke, "EM", sq. cage
(3)	5	440/220	1500	3	25	G. E., "KT", sq. cage
(4)	5	440/220	750	3	25	Burke, "EM", sq. cage
(1)	5	440/220	500	3	25	G. E., "KT", sq. cage

The above is a partial list; quotations covering other machines upon request.

D. C. MOTORS

Stk. No.	*Hp.*	*Volts*	*Speed*	*Make and Type*
1360	500	230	440	G. E. (Spr.), "C", interpole, 3-brg.
1361	500	230	440	G. E. (Spr.), "C", interpole, 3-brg.
1631	250	115	210	G. E. (Spr.), "C", interpole, 3-brg.
0630	230	115	210/420	G. E. (Spr.), "C", interpole, 3-brg.
2631	75	115	600	G. E. (Spr.), "C", interpole
209	60	115	650	G. E., "DLC", interpole
1362	60	115	500/700	G. E. (Spr.), "C", interpole
902	50	115	650	G. E., "DLC", interpole
952	35	500	650	G. E., "CLB"
1124	30	230	725/1000	G. E. (Spr.), "LC", interpole
1011	30	230	1200	G. E. (Spr.), "LC", interpole
1125	25	230	750/1000	G. E. (Spr.), "LC", interpole
1126	20	230	1150	G. E., "RC", interpole
1127	20	230	1150	G. E., "RC", interpole
1128	20	230	1150	G. E., "RC", interpole
(2)	5	230	975	G. E., "RC", interpole

The above is a partial list; quotations covering other machines upon request.

D. C. GENERATORS

Stk. No.	*Kw.*	*Volts*	*Speed*	*Make and Type*
9630	400	250	500	G. E. (Spr.), "C", interpole, 3-brg.
8631	200	125	230	G. E. (Spr.), "C", interpole, 3-brg.
7631	60	125	650	G. E. (Spr.), "C", interpole
2902	40	125	750	G. E., "DLC", interpole
839	30	550	750	G. E., "CLB"
2211	30	250	850	G. E. (Spr.), "LC", interpole
7122	25	250	825	G. E. (Spr.), "LC", interpole
6211	17½	230	1150	G. E., "RC", interpole
9211	15	230	1150	G. E., "RC", interpole
1311	12½	250	950	G. E., "RC", interpole
2311	10	250	975	G. E., "RC", interpole
7979	7½	125	950	G. E., "RC", interpole
879	5	125	950	G. E., "RC", interpole

The above is a partial list; quotations covering other machines upon request.

A. C. DIRECT CONNECTED UNIT

1—125-kva., 2300-volt (will reconnect for either 220 or 440-volt), 200-r.p.m., 3-phase, 60-cycle General Electric, Type ATB, revolving field Generator direct connected to 16 in. x 18 in., side crank Erie City Simple Engine, with accessories.

A. C. BELTED GENERATORS

Stk. No.	*Kva.*	*Volt*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
Cons.	375	2300	450	3	60	G. E. "ATB"
1411	312	2300	600	3	60	G. E. "TRB"
1404B	187½	2300	720	3	60	G. E., "ATB", complete
1489	125½	2300	900	3	60	G. E., "ATB", complete
1405	125	2200	900	3	60	Allis-Chal., rev. field
1406	100	2200	900	3	60	Allis-Chal., rev. field
1016	60	240/480	1200	3	60	Westinghouse, complete
1424	60	2300	1200	3	60	Ideal revolv. field, complete

SYNCHRONOUS CONDENSERS

Stock Nos. 1503, 1503: (2) New, 700-kva., 900-hp., 2300-volt, 450-r.p.m., 3-ph., 60-cy. revolving field, self-starting, two-bearing Electric Machinery Co., each self-starting, and complete with starting apparatus.

"New Motors in Pittsburgh Stock"

D.C. MOTORS

115 Volt

Qu.	Hp.	Rpm.	Volt	Make	Type	Wind	Tem
2	2	1180	115	Wghse.	CD	Cpd.	40
2	3	1725	115	Wghse.	CD	Cpd.	40
2	15	1150	115	G.E.	RC	Cpd.	40

230 Volt

1	1	1725	230	Wghse.	CD	Cpd.	40
2	1	1150	230	G. E.	RC	Cpd.	50
2	1½	900	230	Wghse.	CD	Cpd.	50
1	2	1140	230	Wghse	CD	Cpd.	40
2	2	1725	230	Wghse.	CD	Cpd.	40
7	2	1150	230	G. E.	MC	Cpd.	40
1	2	1200	230	C.-W.	CCM	Cpd.	40
6	3	1150	230	G. E.	MC	Cpd.	40
2	3	1700	230	G. E.	MC	Cpd.	40
2	3	1725	230	Wghse.	CD	Cpd.	40
2	3	1725	230	Wghse.	CD	Cpd.	40
		(Semi-enclosed)					
6	3	1100	230	C.-W.	CCM	Cpd.	40
3	3	1800	230	C.-W.	CCM	Cpd.	40
1	5	960	230	C.-W.	CCM	Cpd.	40
1	5	1700	230	G. E.	MC	Cpd.	40
1	7½	850	230	G. E.	RC	Cpd.	50
1	7½	1150	230	G. E.	RC	Cpd.	50
4	7½	1425	230	C.-W.	CCM	Cpd.	40
1	10	1150	230	Wghse.	SK	Cpd.	40
1	15	1250	230	Wghse.	SK	Cpd.	40
1	15	400/1600	230	Reliance	.....	Cpd.	40
1	30	1700	230	Reliance	.....	Shunt	40
1	35	1650	230	Reliance	.....	Cpd.	40
1	40	1700	230	Wghse.	SK	Cpd.	40
1	50	1100	230	Wghse.	SK	Cpd.	40
1	50	1700	230	Wghse.	SK	Cpd.	40
1	60	1700	230	Wghse.	SK	Cpd.	50
		(Variable speed)					
2	75	1700	230	Wghse.	SK	Cpd.	40

550-Volt

3	2	1250	550	G. E.	MC-2	Cpd.	40
4	2	1350	550	Wghse.	CD	Cpd.	
				3 are 50; others are			40
1	3	1200	550	Wghse.	SK	Cpd.	40
1	3	1800	550	G. E.	MC	Cpd.	40
8	3	1250	550	G. E.	MC	Cpd.	40
2	3½	900	550	Wghse.	SK	Cpd.	55
		(Totally enclosed)					
4	2	1490	550	C.-W.	CCM	Cpd.	40
10	5	1200	550	C.-W.	CCM	Cpd.	40
12	3	1340	550	C.-W.	CCM	Cpd.	40
1	5	1925	550	C.-W.	CCM	Cpd.	40
2	5	1800	550	G. E.	MC-3	Cpd.	40
12	5	1250	550	G. E.	MC	Cpd.	40
1	5	1300	550	G. E.	RC	Cpd.	40
2	5	720	550	Wghse.	SK	Cpd.	55
		(Totally enclosed)					
	5	850	550	Wghse.	SK	Cpd.	55
		(Totally enclosed)					
1		1150	550	Wghse.	SK	Shunt	40
3	7½	1300	550	G. E.	RC	Cpd.	50
1	7½	950	550	C.-W.	CCM	Cpd.	40
3	10	1800	550	G. E.	RC	Cpd.	40
8	10	1150	550	Wghse.	SK	Cpd.	40
5	10	1700	550	Wghse.	SK	Cpd.	40
2	15	825	550	Wghse.	SK	Cpd.	40
1	20	1020	550	Wghse.	S	Cpd.	40
		(Second Hand)					
1	25	820	550	Wghse.	SK	Cpd.	40
1	30	1700	550	Wghse.	SK	Cpd.	40
1	30	900	550	G. E.	RC	Shunt	50
1	40	875	550	G. E.	RC	Cpd.	50
1	40	1750	550	Reliance	.....	Cpd.	40
2	50	1750	550	Wghse.	SK	Cpd.	40
		(Rebuilt)					
1	50	1700	550	Wghse.	S	Cpd.	40
1	6-kw.	1850	125	G. E.	ML	Shunt Generator	

SINGLE PHASE

110/220-Volt, 60-Cycle, 40-Deg.

Qu.	Hp.	Rpm.	Make
3	¼	1750	Century
2	¼	1750	Century (Vertical)
1	¼	1140	Wagner
2	¼	1725	Wagner (one used)
2	¾	1165	Century
2	1	1165	Century
6	1	1725	Wagner
2	1	1165	Wagner
9	1½	1725	Wagner
2	1½	1165	Century
3	1½	1750	Century
10	2	1165	Century (one second hand)
1	2	1750	Century
9	2	1150	Wagner
1	2	1750	Wagner
6	3	1750	Wagner
4	3	1160	Wagner
11	3	1750	Century (one used)
1	3	1165	Century
1	5	1165	Wagner
6	5	1740	Wagner
1	10	1165	Century

A.C. MOTORS

3-Phase, 110-220-440-Volt, 60-Cycle

Qu.	Hp.	Rpm.	Volt	Make	Type	Tem
1	25	1200	220	G. E.	KT	50
1	25	1750	220	Wghse.	CS	40
1	30	1160	220	Wghse.	CW	40
		(Slip ring)				
1	30	1800	220	G. E.	KT	50
1	30	865	220	Allis-C.	...	40
		(Slip ring)				
1	40	1800	220	G. E.	KT	50
2	50	1800	220	G. E	KT	50
1	60	1800	220	G. E.	KT	50
1	100	1750	220	Wghse.	CS	40
2	1	1800	440	G. E.	KT	50
2	1	1200	440	G. E.	KT	50
3	3	1160	440	Wghse.	CS	50
2	3	1130	440	C.-W.	...	40
2	3	1800	440	Lincoln	...	40
1	3	1200	440	G. E.	KT	50
10	3	1800	440	G. E.	KT	50
1	5	1750	440	Wghse.	CS	50
3	5	1720	440	C. W.	...	40
14	5	1800	440	G. E.	KT	50
3	5	1200	440	G. E.	KT	50
9	5	900	440	G. E.	KT	50
4	7½	1750	440	Wghse.	CS	50
11	7½	1800	440	G. E.	KT	50
		(Three are 40 deg.)				
1	7½	1200	440	G. E.	KT	50
1	10	1800	440	G. E.	KT	50
1	20	1200	440	G. E.	KT	50
1	25	1200	440	G. E.	KT	40
1	30	1160	440	Allis-C.	...	40
		(Slip ring)				
1	35	720	440	G. E.	I-K	40
2	40	1200	440	G. E.	KT	50
1	60	1800	440	G. E.	KT	50
2	150	1800	440	G. E.	KT	50
1	200	1800	440	G. E.	I-K	40

3-Phase, 2200-Volt, 60-Cycle, 3-Phase

1	75	1800	2200	G. E.	I-K	40
2	150	1800	2200	G. E.	KT	50

2-Phase, 110-220-Volt, 60-Cycle

Qu.	Hp.	Rpm.	Volt	Make	Type	Tem
1	1	1200	110	G. E.	KQ	40
6	1	1800	220	G. E.	KQ	50
1	1½	1800	220	G. E.	KQ	50
1	2	1725	220	Wghse.	CSA	40
1	7½	1800	220	G. E.	KQ	40
1	15	1800	220	G. E.	KQ	40
		(Rebuilt)				

3-Phase, 110-220-440-Volt, 60-Cycle

1	1	1200	110	G. E.	KT	50
1	1	1140	220	C.-W.	...	40
2	1	1200	220	G. E.	KT	50
1	1	1750	220	R. & M.	...	40
9	1	1800	220	G. E.	KT	50
1	1	3600	220	G. E.	KT	40
2	1½	1800	220	G. E.	KT	50
1	2	1750	220	Swaby	vertical	40
7	2	1200	220	G. E.	KT	50
1	2	1160	220	Wghse.	CS	50
1	3	1200	220	G. E.	KT	40
4	3	1200	220	G. E.	KT	50
1	3	1160	220	Wghse.	CS	50
2	3	1710	220	C.-W.	...	40
2	3	1800	220	G. E.	KT	50
12	5	1800	220	G. E.	KT	50

HARRIS PUMP & SUPPLY CO. 316-318-320-322 Second Ave. 319-321 First Avenue **Pittsburgh, Pa.**

THE RANDLE MACHINERY COMPANY, *ESTABLISHED 36 YEARS*

1822 Powers Streets, CINCINNATI, OHIO

A. C. GENERATORS
Belted and Direct Connected

1—5000-kw. General Electric Vertical, 3-phase, 60-cycle, 4500-volt Turbo Generator Set, with condenser and accessories.
1—1200-kw. General Electric, 3-phase, 60-cycle, 250-volt Generator, direct connected to Filer & Stowell, cross compound, Corliss Engine.
1—600-kw. General Electric, 3-phase, 60-cycle, 250-volt Generator, direct connected to an 18 x 42 x 36 Filer & Stowell Corliss Engine.
1—500-kw. Westinghouse, 3-phase, 60-cycle, 2300-volt Generator, direct connected to a 26 x 42 Hamilton Corliss Engine.
1—300-kw. Westinghouse, 3-phase, 60-cycle, 220-volt Generator, direct connected to a 26 x 42 Murray Corliss Engine.
1—300-kw. General Electric, 3-phase, 60-cycle 2300-volt Turbo Generator Set, condensing.
1—250-kw. Westinghouse, 3-phase, 60-cycle, 220-volt Alternator, direct connected to a 22 x 42 Murray Heavy Duty Corliss Engine.
1—250-kva. Allis-Chalmers, 3-phase, 60-cycle, 2300-volt, 600-r.p.m. belted type Alternator.
2—200-kw. each, DeLaval-Bullock, 3-phase, 60-cycle, 220-440-volt Turbo Generator Sets, with condensers and accessories.
1—125-kva. Ft. Wayne, 3-phase, 60-cycle, 1150-2300-volt Generator, direct connected to a 15 x 16 Erie-Ball Automatic Engine, with accessories.
1—100-kw. General Electric, 3-phase, 60-cycle, 220-volt, 3600-r.p.m. Turbo Generator Set, with condenser and accessories.
1—62 ½-kw. Lincoln, 3-phase, 60-cycle, 480-volt Generator, direct connected to an 11 x 12 Chandler & Taylor Automatic Engine.

D. C. GENERATORS
Belted and Direct Connected

1—510-kw. Crocker-Wheeler, 300-volt, compound wound Generator, direct connected to a 19 x 40 x 36 McIntosh & Seymour Engine.
1—300-kw. Triumph, 250-volt, compound wound Generator, direct connected to a 15 x 28 x 30 Hamilton Cross Compound Corliss Engine.
1—250-kw. Triumph, 125-volt Generator, direct connected to a 22 x 20 Skinner Automatic Engine. (Can be rewound for 250 volts.)
2—150-kw. Westinghouse, 275-volt, 200-r.p.m. Generators, each direct connected to an 18 x 19 Fleming-Harrisburg Automatic Engine.
1—125-kw. Fort Wayne, 230-volt, compound wound Generator, direct connected to a 17 x 16 Skinner Automatic Engine.
1—100-kw. Triumph, 125-volt, 675-r.p.m., compound wound, belted type Generator.
1—75-kw. Ft. Wayne, 250-volt, compound wound Generator, direct connected to a Skinner Automatic Engine.
1—38 ½-kw. Western Electric, 250-volt, compound wound Generator, direct connected to a 9 x 12 Skinner Engine.
1—35-kw. Triumph, 125-volt, compound wound, Generator, direct connected to a 9 x 12 Skinner Automatic Engine.
1—22 ½-kw. Allis-Chalmers, 120-volt, 187.5 amps. 925-r.p.m., compound wound, belted type Generator.
1—20-kw. Western Electric, 1250-r.p.m., 120-volt, compound wound, belted type Generator.
1—17 ½-kw. Triump.s, 125-volt, 140-ampere, 1250-r.p.m., compound wound, belted type Generator

BOILERS

6—1040-hp. Edgemore, ASME code, 200-lb. pressure.
8—520-hp. Stirling, 175-lb. pressure.
3—250-hp. Franklin, Heine type, 150-lb. pressure.
3—207-hp. Geary, Heine type, 175-lb. pressure.
2—175-hp. Atlas, 150-lb. pressure.
1—175-hp., 78 x 18, high pressure, H.R.T.
4—150-hp., 72 x 18, high prcssure, H.R.T.
6—125-hp., 72 x 16, high pressure, H.R.T.
2—100-hp., 66 x 16, high pressure, H.R.T.
2—100-hp., 66 x 16, Standard, H.R.T.
1— 80-hp., 60 x 16, high pressure, H.R.T.
1— 60-hp., 54 x 14, high pressure, H.R.T.
1— 50-hp., 48 x 120, high pressure, Vertical.
1— 75-hp., high pressure, Fire Box.
1— 40-hp., high pressure Fire Box.
2— 25-hp., 42 x 95, new Vertical, 125-lb. pressure.
1— 15-hp., 36 x 83, new Vertical, 100-lb. pressure.
1— 10-hp., 30 x 83, new Vertical, 100-lb. pressure.

STEAM ENGINES

1—26 x 48 Vilter left-hand Corliss.
1—17 x 34 x 48 Hamilton, Corliss Comound, heavy duty, Corliss, designed for rope drive.
1—22 x 42 Hamilton heavy duty Corliss.
1—22 x 42 Allis heavy duty Corliss.
3—18 x 36 Allis-Chalmers, heavy duty, Corliss.
1—16 x 16 Lane & Bodley Slide Valve.
1—14 x 18 Erie City Iron Works Automatic.
1—13 x 16 Erie City Iron Works Automatic.
1—13 x 16 Chandler & Taylor Slide Valve.
2—10 x 12 Valley Iron Works Automatic.
1—10 x 12 Chandler & Taylor Slide Valve.
1— 9 x 12 Skinner Automatic.

Also many other sizes.

MOTOR GENERATOR SETS

2—500-kw. Westinghouse, 250-volt, D.C., 720-hp. 3-phase, 60-cycle, 2300-volt Synchronous Motor Generator Sets.

ROTARY CONVERTERS

2—200-kw. Westinghouse, 250-volt, D.C.; 3-phase, 60-cycle, Rotary Converters.

A. C. MOTORS
3-Phase, 60-Cycle
Squirrel Cage and Slip Ring

No.	Hp.		Make	Volts	Rpm.
12	7½	New	General Electric	220	1800
6	10	New	General Electric	220	1200
2	15	New	Fairbanks-Morse	440	1750
5	15	New	General Electric	220	1200
1	20	Used	Fairbanks-Morse	220	1200
5	20	New	General Electric	220	1200
5	25	New	General Electric	220	1200
1	25	New	G. E. (Slip Ring)	220	1200
3	30	New	General Electric	220	1200
4	40	New	General Electric	220	1200
4	50	New	General Electric	220	900
1	50	Rebuilt	General Electric	220	900
3	50	New	G. E. (Slip Ring)	440	900
3	75	New	G. E. (Slip Ring)	220	900
3	100	New	G. E. (Slip Ring)	220	900
1	100	Rebuilt	Westinghouse	220	1200
2	150	New	G. E. (Slip Ring)	440	720
1	200	Used	General Electric	2200	514
1	250	New	A.-C. (Slip Ring)	2200	514
1	275	Used	G. E. (Slip Ring)	240	600
1	960	New	G. E. Synchronous	550	720

Also many other sizes and types.

Any of the above 220 volt motors can be furnished for 440 volt, or vice versa.

D. C. MOTORS

No.	Hp.		Make	Volts	Rpm.
1	50	Rebuilt	Allis-Chalmers	250	800
1	40	Rebuilt	Jantz & Leist	250	800
3	30	Used	Jantz & Leist	250	600
1	20	Rebuilt	Triumph	250	965
1	15	Rebuilt	Minneapolis	110	350
1	12½	Rebuilt	Minneapolis	220	950
1	7½	Rebuilt	Jants & Leist	220	800
2	5	Rebuilt	Triumph	220	1350
1	5	Rebuilt	Jantz & Leist	220	900
2	4	Rebuilt	Triumph	110	1025

Also many other sizes and types.

OUR SHOPS AND EXPERIENCE ARE AT YOUR SERVICE

MAC GOVERN & COMPANY, INC.
POWER MACHINERY
114 Liberty St. New York, N.Y.

Offerings for Prompt Shipment

Turbo-Generator Units—60 Cycle

100 kw. General Electric-Curtis, non-condensing, 2200 volts, 3600 r.p.m., 150 lbs. steam pressure, with dir. conn. exciter and complete switchboard equipment.

187 kva. Westinghouse-Parsons, non-condensing, 240 volts, 3600 r.p.m., 125 lbs steam pressure, with dir. conn. exciter.

500 kw. Allis Chalmers, non-condensing, 480 volts, 3600 r.p.m., 140 lbs. steam, 5 lbs. back pressure with dir. conn. exciter and complete switchboard equipment.

500 kw. Westinghouse-Parsons, condensing, 2400 volts, 3600 r.p.m., 170 lbs. steam, 28 in. vacuum, with dir. conn. exciter, switchboard equipment and condenser with accessories.

500 kw. General Electric-Curtis, condensing, 480 volts, 3600 r.p.m., 135-150 lbs. steam, with dir. conn. exciter.

1000 kw. Westinghouse-Parsons, condensing, 2300 volts, 3600 r.p.m., 175 lbs. gauge at throttle.

1000 kw. Allis-Chalmers, condensing, 6600 volts, 1800 r.p.m., 150 lbs. steam, parallel flow, reactance type, with dir. conn. exciter, switchboard, condenser and auxiliaries.

1200 kw. Allis-Chalmers, non-condensing, 480 volts, 3600 r.p.m., 150 lbs. steam, 5 lbs. back pressure, with dir. conn. exciter.

1250 kw. Westinghouse-Parsons, condensing 480 volts, 3600 r.p.m. 150 lbs. steam, with surface condenser and auxiliaries.

Rotary Converters

2—300 kw. Westinghouse rotary converters 6 phase, 25 cycle, 250 volts, 750 r.p.m., self exciting, 250 volts, D.C., 1200 amps. D.C. With each rotary there is one 300 kva. Westinghouse transformer, 3 phase, 13,000/192 volts, complete with oil.
These machines have been used only six months.

1—300 kw. Westinghouse rotary converter, 6 phase, 60 cycle, compound wound, interpole, 250 volts D.C., 1200 amps. D.C., 1200 r.p.m., with three 110 kva. Westinghouse type SKR transformers, single phase, 6600/6300/6000 to 189/61.5 volts.

A. C. Engine-Generator Units

100 kva. Westinghouse, 2 ph., 60 cy., 240 v., 277 r.p.m., dir. conn. to 13 in. x 15 in. Skinner side crank engine, with belted exciter and complete switchboard.

125 kva. Crocker-Wheeler, 3 ph., 60 cy., 2300 v., 257 r.p.m., dir. conn. to 11 in. and 22 in. x 14 in. Watertown T. C. engine, with dir. conn. exciter and switchboard equipment.

150 kw. Allis-Chalmers, 3 ph., 60 cy., 2300 v., 225 r.p.m., dir. conn. to 19 in. x 20 in. Skinner Universal uniflow engine.

312 kw. General Electric, 3 ph., 60 cy., 2300 v., 120 r.p.m., dir. conn. to 20 in. x 36 in. Murray-Corliss rolling mill type engine, with belted exciter.

500 kw. Westinghouse, 3 ph., 60 cy., 2300 v., 120 r.p.m., dir. conn. to 26 in. x 42 in. Hamilton-Corliss engine.

Also Boilers, Condensers, etc. *Wire for Prices*

NOTHING BUT GOOD EQUIPMENT

New and Used—Guaranteed Condition—Ready to Ship

Slip Ring Motors—3-Phase, 60-Cycle

Hp.	Volt	Speed	Make	Type
500	2200	600	General Electric	M
300	2200	600	General Electric	M
250	2200	600	General Electric	M
200	2200	600	General Electric	M
200	220/440	600	General Electric	M
150	2200	720	General Electric	M
150	2200	600	General Electric	M
150	440/220	720	General Electric	M
100	440/220	720	General Electric	M
100	2200	720	General Electric	M
100	440/220	900	General Electric	M
75	550	900	General Electric	MT
75	550	600	General Electric	M
75	2200	720	General Electric	M
75	220/440	720	General Electric	M
75	440/220	900	General Electric	M
60	220/440	1200	General Electric	MT
60	440/220	900	General Electric	M
50	550	900	General Electric	M
50	440/220	1200	General Electric	MT
50	2200	900	General Electric	M
40	440/220	1200	General Electric	MT
30	440/220	1800	Westinghouse	HF

Squirrel Cage—3-Phase, 60-Cycle

150	2200	720	General Electric	K
100	2200	600	General Electric	K
100	440/220	900	General Electric	K
100	440/220	720	General Electric	K
100	2200	900	General Electric	K
75	440/220	900	General Electric	K
50	440/220	1200	General Electric	K
50	440/220	900	General Electric	K
50	550	900	General Electric	K
35	220/440	720	General Electric	K
25	440/220	900	General Electric	K
25	440/220	600	General Electric	K
25	440/220	600	Allis-Chalmers	AN
25	220/440	720	General Electric	K
25	440/220	1200	Westinghouse	CS
20	440/220	1200	General Electric	I.

3-Phase, 25-Cycle

500	2200	500	General Electric	Sl. rg.
300	440	500	General Electric, sl. rg.	
200	440	500	General Electric, sl. rg.	
50	220/440	750	General Electric, sq. ca.	
25	220/440	750	Westinghouse, sl. rg.	

DIRECT CURRENT MOTORS

Hp.	Volt	Speed	Make	Type
200	230	600	Westinghouse	
175	115	525	Crocker-Wheeler, Interp.	
125	115	500	Westinghouse, Interpole	
100	115	300	Westinghouse, Compound	
90	115	660	Crocker-Wheeler	D
75	115	400	Crocker-Wheeler	D
75	230	1100	Westinghouse	S
75	115	475	Westinghouse	SA
75	500	750	Westinghouse	M
50	550	565	Westinghouse	SK
35	230	800	Westinghouse	S
30	230	300	Westinghouse	M
30	230	700	G. E.-Sprague	D
25	230	750	Crocker-Wheeler	I
15	230	1250	Allis-Chalmers, Interpole	
15	230	575	Westinghouse	S

DIRECT CURRENT GENERATORS

Kw.	Volts	Speed	Make	Type
175	250	690	Westinghouse	
150	125	580	Crocker-Wheeler, Interpole	
125	125	580	Westinghouse, Interpole	
70	125	575	Westinghouse	SA
50	250/125	1150	Westg. Interpole	8A
45	125	975	General Electric	CLB
33	125	725	General Electric	Sprague
30	250	850	G. E. Sprague	D
30	125	800	Crocker-Wheeler	D
23	125	1175	Crocker-Wheeler	I

MOTOR GENERATOR SETS

1—150 Kw. 280/140-v., 900 r.p.m., Gen. Electric., Type D L C Interpole D.C. Generator direct connected to 225 H.P. 4000/2300-v., 3-ph., 60 cy., Gen. E ee. Form L. motor, complete with D.C. and A. C. panels.

1—100-kw., 250-volt, 900 r.p.m., Whse. Type 8A Interpole Generator, coupled to 100 kva., 2300/440/220, 3-ph., 60 cy., Whse. Syn. Motor

2—75-kw., 125-volt, 1150 r.p.m., Gen. Elec. Type DLC Generator connected to 115-hp., 440/220 volt, 3-ph., 60-cy. Gen. Elec. S Cage motor.

1—70-kw., 125-volt, 690-r.p.m. Westinghouse 8A Interpole Generator, coupled to 100-hp., 2200/440/220-volt, 3-phase, 60-cycle Gen. Elec. S Cage motor.

1—50 Kw., 250/125-volt, 1150 r.p.m., 3-wire, Westg. Interpole Generator coupled to 75 H.P. 440/220 v., 3-ph., 60-cy. G. E. sq. cage motor.

ALTERNATING CURRENT GENERATORS

1—225-kva. Westinghouse, 220-volt, 514-r.p.m., 2- or 3-phase, 60-cycle, R. F. Generator, with belted exciter.

1—200-kw. Allis-Chalmers, 2300-volt, 600-r.p.m. 3 or 2-phase, 60-cycle, RF Generator with direct connected Exciter.

1—100-kva. Westinghouse, 2300/480/240-volt, 900-r.p.m., 3-phase, 60-cycle, R. F. Generator, with belted exciter, complete.

ENGINE GENERATOR SETS

1—80-kw., 250/125-volt, 3-wire Sprague G.E., D.C., Generator connected to Ridgway 13x14, 280 r.p.m. side crank engine.

1—75-kva. 240-volt, 277-r.p.m., 60-cy., 2 or 3-ph. Westinghouse A.C.Generator direct connected to 12 x 14 Erie Ball side crank engine with exciter and switchboard panel.

1—75-kw., 125-volt, 275-r.p.m., Crocker-Wheeler, direct current Generator, direct connected to 14 x 14 Erie Ball side crank engine.

TURBO GENERATOR SETS

1—650-kva. Westinghouse Parsons 480/240-volt, 3-ph., 60-cy., 3600 r.p.m., with Westinghouse Le Blanc jet condenser and exciter.

1—75-kw. 125 V., 2400 r.p.m., G. E. 2-stage, direct current turbo generator.

If your requirements are not listed, write us, as we do not attempt to list our entire stock.

STEPHEN HALL & CO., Inc., 7th and Adams Streets, Hoboken, N. J.

TELEPHONES: New York Direct Wire: Rector 3891; HOBOKEN 3750

Power Machinery Exchange

1 Montgomery Street, Jersey City, N.J.

A. C. Direct Connected Units
3-Phase. 60-Cycle

Kva	*Generator*	*Engine*
500	Westghse.	Parsons Hor. Turbine
400	Allis-Chal.	Allis-Chal.-Corliss
360	Gen. Elec	Harris Comp. Corliss
340	Westghse.	Harrisburg, 4-valve
300	Gen. Elec.	Allis-Chal.-Corliss
250	Allis-Chal.	Hamilton Non-releasing
250	Westghse.	Chuse, 4-valve
240	Gen. Elec.	Harrisburg, 4-valve
200	Westghse.	Erie Ball, side crank
187	Westghse.	Parsons Hor. Turbine
165	Westghse.	Erie Ball
150	Gen. Elec.	Harrisburg, 4-valve
135	Westghse.	Harrisburg, 4-valve
125	Gen. Elec.	Curtis Hor. Turbine
100	Westghse.	Harrisburg, 4-valve
100	Cr.-Wheeler	Harrisburg
75	Gen. Elec.	Skinner
50	Westghse.	Skinner

A. C. Belted Generators
3-Phase, 60-Cycle

Kva.	*Make*	*Speed*
800	Allis-Chal., 3 Brg.	360
500	Allis-Chal.	600
375	Gen. Elec.	450
360	Westghse.	360
350	Gen. Elec., 3 Brg.	514
312	Gen. Elec.	450
275	Westghse.	450
250	Gen. Elec.	600
200	Westghse.	600
150	Gen. Elec.	600
120	Westghse.	900
100	Gen. Elec.	900
75	Gen. Elec.	900
50	Gen. Elec.	1200
40	Elec. Mchy.	1200
35	Cr.-Wheeler	1200
30	Westghse.	1200
20	Fairbanks-Morse	1800
15	Fairbanks-Morse	1800

Direct Current Units
220-250-Volt

Kw.	*Generator*	*Engine*
400	Gen. Elec.	Buckeye Comp.
300	Cr.-Wheeler	Watts-Campbell-Corliss
300	Westghse.	Lane Bodley Corliss
250	Ridgway	Ridgway, side crank
250	Cr.-Wheeler	Harrisburg
200	Gen. Elec.	Erie, 4-valve
150	Gen. Elec.	Ames Uniflow
150	Westghse.	Hewes-Phillips-Corliss
150	Ridgway	Ridgway
100	Allis-Chal.	Skinner
100	Ridgway	Ridgway, 4-valve
75	Gen. Elec., 3-wire	Ridgway
60	Gen. Elec.	Ball
60	Gen. Elec. 3-wire	Skinner Uniflow
50	Gen. Elec.	Harrisburg
37½	Westghse.	Skinner
40	Gen. Elec. 3-wire	Skinner Uniflow

Send for complete list of Generators, Motors, Engines, Boilers, etc.

TRANSFORMERS

60 CYCLE

2—1000-kw. Westg., O.I.W.C., 33,000 v. prim., 2300 secy., Scott conn.
6—600-kva. G. E., single ph., O.C. Type H, 33,000 v. prim., 13,200 secy.
3—500-kva. G. E., O.I.S.C., Type H, single ph., 2200 v. prim. 550 secy., Scott connected.
4—500-kw. Westg., O.I.W.C., 33,000 v. prim., 2300 secy., Scott conn.
2—500-kw. Westg., 33,000 v. prim., 2670 secy., Scott connected.
4—500-kva. G.E., Type A, Form L, agle. ph., outdoor type, 12420/13800 v. prim., 230/460 secy.
3—400-kva. Allis-Chal., single ph., indoor type, 6600 v. prim., 440 secy.
4—400-kva. Pittsburgh, single ph., 6600 v. prim., 440/220 secy.
3—150-kva. G. E., Type H, single ph., 6000/6300/6600 v. prim., 120/240 secy.
3—110-kw. G. E., Type H., single ph., 14500/13050 v. prim., 430/286/-143 secy.
3—100-kw. G. E., single ph., 9200 v. prim., 2300 secy.
3—100-kw. Westg., single ph., Type S., 440 v. prim., 220 secy.
3—100-kva. G. E., Type H., indoor type, 6600 v. prim., 605/545 secy.
3—100-kva. Pittsburgh, outdoor type, single ph., 6600 v. prim., 2300 secy.
3—75-kva. Allis-Chal., single ph., O.I.S.C., outdoor type, 6600 v. prim., 440/110 secy.
3—75-kva. G. E., Type H., single ph., 11,000/9900 v. prim., 6600 secy.
3—50-kva. Westg., O.I.S.C., Type SK, single ph., 6600/6300/6000 v. prim., 440/220 secy., outdoor type.

25 CYCLE

1—1500-kw. G. E., 3 ph., 13,200 v. prim., 6600 secy., O.C.
6—500-kva. Westg., O.I.S.C., indoor type, single ph., 13,200 v. prim., 6600 secy.
3—150-kva., G. E., O.C., single ph., 13200/6600 v. prim., 220/440 secy.
3—50-kva. G. E., single ph., O.C., 13,800 v. prim., 115/230 secy.
3—25-kva., Kuhlman, single ph., 7200 v. prim., 440 secy.

ARCHER & BALDWIN, INC., 114-118 Liberty St., N. Y. C.
LONG DISTANCE TELEPHONES 4337-4338 RECTOR

Brand New Units

For Shorter Delivery

1—120 kva., 60 cyc., 3 ph., 2300 v., 225 r.p.m., Western Electric Alternator, directly connected to a CHUSE Non-releasing Corliss engine. With belted exciter.

1—312 kva., 60 cyc., 3 ph., 480 v., 200 r.p.m., Western Electric Alternator, directly connected to a CHUSE condensing Uniflow or Non-releasing Corliss engine. With belted exciter.

1—450 kva., 60 cyc., 3 ph., 2300 v., 150 r.p.m., General Electric Alternator, directly connected to CHUSE condensing Uniflow or Non-releasing Corliss engine. With belted exciter.

1—400 kw., 250/275 v., 150 r.p.m., General Electric D.C. Generator, directly connected to a CHUSE Non-releasing Corliss engine. With standard, single panel switchboard.

USED UNIT

1—150 kw., 250 v., Westinghouse D.C. Generator, directly connected to a CHUSE single valve, side crank engine. With single panel switchboard.

Chuse Engine & Manufacturing Company
Mattoon, Illinois

Rebuilt ELECTRIC MOTORS in Stock

Send for Complete List and Prices

210-220-Volt D.C. Motors

HP.	R.P.M.	MAKE
1— 2	1200	Westinghouse, R
1— 2	1150	Western Elect RC
1— 3	1650	G. E. C.V.C.
1— 3	1050	Crocker-Wh. MC
1— 5	1150	Westinghouse S.
2— 5	1650	G. E. C.V.C.
1— 5	950	Crocker-Wheeler
1— 7½	1525	G. E. C.V.C.
1— 7½	1200	Robbins & Myers
1— 10	850	Crocker-Wheeler
1— 10	1050	Westinghouse, S
1— 15	800	Crocker-Wheeler
3— 15	825	West. Elec., E
1— 20	600	Peerless
1— 20	1300	Westinghouse S.
1— 20	800	Westinghouse, S
1— 25	875	Crocker-Wheeler
2— 27½	600	Northern
1— 30	650	Bullock

220-440-Volt, 3-Phase, 60-Cycle, A.C Motors

HP.	R.P.M.	MAKE
1— 3	1800	Wagner
1— 3	1200	G. E., Slip-Ring
6— 5	1800	Lincoln (new)
2— 5	1800	Wagner, B.P.
1— 5	900	Howell
11— 7½	200	Lincoln
1— 7½	1200	G. E. (new)
1— 7½	1200	Gen. Elec., KT
1— 10	1200	Western Elec.
1— 15	1800	Crocker-Wheeler
1— 15	1200	Westghse., C.C. L
1— 15	720	Crocker-Wheeler
2— 20	1800	Howell
1— 30	875	Allis-Chalmers
2— 40	1150	Allis-Chalmers
1— 50	1150	Gen. Elec. K.T.
1— 50	514	Lincoln, Slip-Rg.

WE BUY—SELL REPAIR EXCHANGE and RENT

THOMPSON & JAMESON, Inc., 366 W. Superior St., CHICAGO, ILL.

TRANSFORMERS

50,000 Kilowatts—All Sizes

Government Apparatus—Little Used

Motors—Dynamos

5,000 To Select From

GEORGE SACHSENMAIER CO.
928 N. Third St., Philadelphia, Pa.
LET US KNOW WHAT YOU WANT ELECTRICALLY.

R. SCHEINER & Co.
123 North 3rd St.
PHILADELPHIA

110-volt, Direct Current Motors and Generators

Qu.	Hp.	Make	Type	Speed		Price
1	1/25	General Electric	SDA	1700	Shunt	$6.00
1	1/20	Westinghouse	.....	1700	Shunt	6.00
1	1/10	General Electric	SD	1700	Shunt	8.00
2	1/8	Westinghouse, new	CDH	1725	Comp.	18.00
1	1/8	Janette	D18	1750	Shunt	10.00
1	1/8	Robbins & Myers	.....	2000	Shunt	8.00
1	7/10	Electric Specialty Co.	R	2277	Shunt	30.00
1	1/6	Crocker-Wheeler	.....	1720	.....	10.00
1	¼	Sturtevant	B	850	Shunt	20.00
1	1/3	Paragon	BRO	3000	.....	18.00
1	½	kw. Eck	.....	1150	Comp.	28.50
1	½	Robbins & Myers	.....	1800	Shunt	28.00
1	½	Diehl	.....	1850	Shunt	28.00
1	¾	Robbins & Myers	.....	1100	Shunt	28.00
13	¾	General Electric, new	SD	1100	.....	40.00
35	¾	General Electric, new	SD	1700	.....	35.00
5	1	General Electric	RC	1800	Shunt	40.00
4	1	General Electric	RC	1850	Comp.	40.00
1	1	Western Electric	RC	1200	Shunt	40.00
3	1	General Electric, new	RC	1150	Shunt	60.00
1	1	General Electric	CA	1175	Shunt	35.00
1	1	Diehl	G	1800	Shunt	35.00
1	1	General Electric	RC	1850	Shunt	40.00
1	1	General Electric	CQ	1275	Shunt	40.00
1	1	Robbins & Myers	.....	1750	Comp.	35.00
3	1	Diehl	.....	1800	Shunt	35.00
1	1	General Electric	DSD	1700	Shunt	35.00
2	1 ½	Robbins & Myers	.....	1800	Comp.	50.00
1	1 ½	General Electric, new	RC	1700	Shunt	60.00
1	1 ½	Eck	2BB	1575/1895	Shunt	50.00
2	2	General Electric, new	RC	1700	.....	65.00
1	2	General Electric	RC	1700	Comp.	55.00
2	2	Crocker-Wheeler	CM	1625	Shunt	50.00
1	2	Rochester	SV2	1650	Shunt	45.00
2	2	Northwestern	KI	1600	Shunt	60.00
1	2	Eck	.....	1750	Comp.	60.00
1	2	General Electric	CVC	1100	Shunt	65.00
1	2 ¼	General Electric	RC	970/1075	Shunt	70.00
1	2 ½	General Electric	CVC	1650	Shunt	65.00
3	2 ½	Eck	3BB	1135/1420	Shunt	75.00
1	3	General Electric	CR	700/1125	Comp.	100.00

Qu.	Hp.	Make	Type	Speed		Price
10	3	Star	SB5	750	Shunt	$85.00
1	3	Sprague	.....	800	.....	85.00
1	3	General Electric	RC	1800	Shunt	75.00
1	3	General Electric	RC	1700	Shunt	75.00
1	3	Robbins & Myers, new	I	1150	Shunt	125.00
1	3	General Electric	.....	1750	Shunt	65.00
1	3	Westinghouse	SK	1150	Shunt	90.00
1	3	Crocker-Wheeler	CM	1800	Shunt	75.00
1	3	Robbins & Myers	.....	1750	Shunt	65.00
1	3	General Electric	RC	1800	Shunt	75.00
1	3	Crocker-Wheeler	CM	1050	Shunt	90.00
1	3 ½	Crocker-Wheeler	SM	1000	Shunt	85.00
1	3 ½	Sturtevant	H	660	.....	110.00
1	3 ½	Northwestern	K3A	1116	Shunt	85.00
1	3 ½	Crocker-Wheeler	.....	1800	Shunt	80.00
1	4	Star	SB7	650	Shunt	115.00
1	4	Burke	A	1100	Shunt	80.00
1	5	Electro Dynamic	4C	810	.....	125.00
1	5	General Electric	CQ	1100	Comp.	100.00
1	5	Western Electric	E	2075	Shunt	85.00
1	5	Robbins & Myers	.....	1400	Shunt	90.00
1	5	Fairbanks-Morse	CP	1750	Shunt	80.00
1	5	Star	SB7	750	.....	100.00
1	5 ¼	Roth	.....	615/810	Shunt	125.00
4	5 ¼	General Electric	RC	855/950	Shunt	115.00
2	7 ½	General Electric	CQ	825	Shunt	150.00
1	7 ½	General Electric	CE	1525	Shunt	125.00
1	7 ½	General Electric	RC	1150	Shunt	150.00
1	7 ½	Crocker-Wheeler	.....	1150	Shunt	125.00
1	7 ½	Westinghouse	SK	1200	.....	150.00
1	7 ¾	Diehl	K	820	Shunt	150.00
1	9 kw.	General Electric	MP	1400	Shunt	125.00
1	10 kw.	Electro Dynamic	.....	1150	Shunt	130.00
2	10	Ilg	.....	500	Shunt	160.00
1	20	Diehl	.....	950	Comp.	200.00
1	25 kw.	C & C	S	1000	Comp.	250.00
1	30	General Electric	RC	1100	Shunt	300.00
1	30	General Electric	CLB	1025	Shunt	300.00
1	37 ½ kw.	Westinghouse	M	900	Comp.	350.00
1	50	Western Electric, new	RC	1075	Shunt	600.00
1	100 kw.	Westinghouse	M	550	Comp.	650.00

POWER

BELTED STEAM ENGINES

7 x 8 Sturtevant vertical, throttling type.
8 x 8 O & S vertical, throttling type.
11 x 12 Ames, Una-Flow.
12 x 12 Erie Ball automatic, center crank.
13 x 12 Harrisburg, 4 valve.
14 x 12 Ames automatic, center crank.
14 x 16 Erie City, automatic, center crank.
15 x 14 Ames automatic, center crank.

Steam Engine Driven Generators, Feed Water Heaters and Air Compressors in Stock

COLEMAN-SHOEMAKER, Inc., Office, Plant and Siding 20th and Clearfield Sts., PHILADELPHIA

"HONESTLY REBUILT" ELECTRICAL MACHINERY

MILLER-OWEN ELECTRIC CO., Inc.
LEXINGTON AVE. AND THOMAS BOULEVARD PITTSBURGH, PENNA.

3-Ph., 60-Cy., 220/440-Volt Motors

Qu.	Hp.	Make	Type	Speed
	5	General Electric	KT	1200
	5	Wagner	BM	1720
6	7 ½	General Electric	KT	1800
2	10	Allis	AN	1200
	10	General Electric	KT	1800
2	10	General Electric	KT	900
50	15	General Electric	KT	900
75	20	General Electric	KT	900
45	25	General Electric	KT	900
3	30	Westinghouse	CX	1200
1	30	Westinghouse	CCL	1800
55	30	General Electric	KT	900
40	35	General Electric	KT	900
21	40	General Electric	KT	900
1	50	Westinghouse	CCL	900
5	50	General Electric	KT	1200
6	60	General Electric	KT	1200
1	60	Westinghouse	CS	900
1	75	General Electric	KT	1200
	100	General Electric		1200

Direct Current Motors

Make	Kw.	Rpm.	Volts
General Electric	105	665	250
General Electric	100	290	250
Crocker-Wheeler	100	900	250
General Electric	75	1200	250
General Electric	75	1200	500
General Electric	75	850	250
General Electric	70	700	250
General Electric	55	845	250
Westinghouse	50	850	250
General Electric	50	550	500
Westinghouse	50	550	250
General Electric	35	550	250
General Electric	30	1700	250
General Electric	25	750	250

3-Ph., 25-Cy., 220/440-Volt Motors

Qu.	Hp.	Make	Type	Speed
2	10	General Electric	KT	750
7	25	Westinghouse	CS	750
1	35	General Electric	CS	750

Direct Current Generators

Make	Kw.	Rpm.	Volts
General Electric	500	360	250
General Electric	400	450	250
Allis-Chalmers	200	425	250
General Electric	150	550	250
General Electric	100	550	250
Crocker-Wheeler	75	1200	250
General Electric	60	900	250
Westg. Erie City	100	250	250
Allis Skinner	100	250	125
G. E. Buckeye	150	200	250
Westg. Bal	200	200	250
Westg. Buckeye	300	150	250
G. E. McIntosh	450	150	250
G. E. Hamilton	500	150	250

Also a number of very attractive offerings in Alternating Current, Belted and Engine Driven Generators.

Motor Generator Sets

Make	Kw.	D.C. Volt	A.C. Volt
General Electric	200	250	2300
General Electric	150	240	2300
Allis	150	500	2300
General Electric	100	250	2300
Burke	75	500	2300
Crocker-Wheeler	75	250	220/440
Allis	75	250	2300
General Electric	65	250	220/440
General Electric	50	250	220/440
Westinghouse	50	125	220/440

A. C. Motors

Make	Hp.	Rpm.	Cycles
General Electric	750	514	60
General Electric	750	750	25
Crocker-Wheeler	600	514	60
Westinghouse	400	450	60
General Electric	300	500	25
General Electric	275	600	60
General Electric	200	450	60
General Electric	150	720	60

"25 CYCLE" MOTORS, TRANSFORMERS MOTOR GENERATOR SETS

Over 1200-25 cycle motors, three phase totalling 15,000 hp. in sizes from 1 to 750 hp. various speeds.
Single and three phase 25 cycle transformers from 1 to 200 kw.
Frequency Changer Sets 25 to 60 cycle.

2—500 kva. G. E. ..... each $6,300
1—500 kva. G.E. direct connected exciter 6,750
1—1000 kva Allis-Chalmers 8,800
2—1250 kva. Westinghouse ..... each 11,800

Prices quoted F.O.B. cars Kansas City, Mo.
All 6600 volt on 25 cycle end and 4150 volt or can be reconnected 2400 volt on the 60 cycle end.
Prices subject to change without notice and subject to prior sale.
Many items almost new and all were in operating condition when removed from service.
This equipment on hand due to a recent change from 25 to 60 cycle distribution.

For details and prices, address

KANSAS CITY POWER & LIGHT COMPANY
Kansas City, Mo.
Attention: W. C. Blair, Industrial Engr.

MOTORS AND GENERATORS

2—200-hp., 450 r.p.m., 3-ph., 440-v., 60-cy., new G. E. Motors.
2—150-hp., 500 r.p.m., 3-ph., 440-v., 25-cy., W. H. & Allis-Chalmers.
2—75-hp., 900 r.p.m., 3-ph., 440-v., 60-cy., F. M. & Allis-Chalmers.
13—50-hp., all speeds, 3-ph., 220- or 440-v., 25- or 60-cy.
1—30-kw., 1050 r.p.m., 125-v., D.C., G. E. Belted Generator.
1—30-kw., 110-v., D.C., Western Elec. Eng. Generator Set.
1—20-kw., 1050 r.p.m., 125-v., D.C., F. M. Belted Generator.
1—6-kw., 35- or 125-v., D.C., G. E. Kerosene Eng. Generator Set.
Large Stock A.C. and D.C. Motors and Generators. All sizes.

V. M. NUSSBAUM & COMPANY, Fort Wayne, Indiana.

MOTORS - DYNAMOS

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L. J. LAND
207 Centre Street **New York**

MOTORS

and other Electrical Equipment, always available.

Send us Your Inquiries

BROWN-HUNKELE CORPORATION
New Jersey's Electrical Clearing House
24-26 Mechanic St., Newark, N. J.

2—150 kw. Ridgway Steam Engine Generator sets, complete with Switchboard, and all fittings.

1—500 kw. Ridgway, 2300-250 v., Motor Generator set.

W. A. CARRELL & COMPANY
211-213-215 Second Avenue, Pittsburgh, Pa.

MOTORS—GENERATORS

New and Rebuilt

We Buy, Sell and Exchange

DAVIS MACHINE & MOTOR CO.
59 Mechanic Street, Newark, N. J.
Phone: Market 8580.

IT'S NOT TOO EARLY

to reserve space for your "Searchlight" advertisement in the

ANNUAL PROGRESS and STATISTICAL NUMBER
January 6, 1923

Complete Circulation—Special Attention
Special Advertising Sections

TRANSMISSION

New and Used Dodge Equipment for Immediate Delivery

Shafting—Cold rolled steel—All sizes and lengths.
Shaft Hangers—All types and sizes
Bearings—Capillary, Ring and Standard Oiling.
Pillow Blocks
Friction Clutches—Dodge Split, Solid and Jaw
Collars—Solid, Split and Thrust
Pulleys—Split and Solid—Cast Iron, Steel and Wood
Bushings
Grease Cups

Our Bulletin No. 15 will give you complete information

Nashville Industrial Corporation
Jacksonville, Tennessee.

Synchronous Motor

1—435 hp., 3 ph., 60 cy., 2300 v., G. E. Type ATI-Form B, 450 r.p.m., 3 Bearing Belted, Type Complete.

"Honestly Rebuilt"

Miller-Owen Electric Co.
Pittsburgh, Penna.

FOR SALE

TRANSFORMERS

Real bargains in slightly used transformers as furnished to War Department for use at Camp McClellan. Guaranteed to be in good condition and may be inspected at Camp Site. Five Pittsburgh Transformer Company's 333 kva., 6600-2300 v., single phase, 60 cy., Nos. 691096-097098-099101, priced at $400 each, f.o.b. Camp McClellan. One Westinghouse Electric Company's 250 kva., 22,000-2300 v., single phase, 60 cy., No. 526474, priced at $600 f.o.b. Camp McClellan. For further information, address

J. GOLDBERG & SONS
812 East 18th Street, Kansas City, Mo.

Ridgway Motor Generator Set

400 kw., 250 v., D.C. Interpole Generator, direct connected to a 625-hp., 2300-v., 3-ph., 60-cy., 1200 r.p.m. Ridgway Slip Ring Motor and Auto. Voltage Regulator. In use 6 mos., original cost $18,600. Our price, $6,000.

THE GLOW ELECTRIC COMPANY
Cincinnati, Ohio.

BRAND NEW

50 hp. General Elec. 3-ph., 60-cy., 220/440 volts, slip ring, 1200 r.p.m. motor.
50 hp. General Elec. 3-ph., 60-cy., 220/440 volts, slip ring, 690 r.p.m. motor.
Will sell at big bargain.

FS-312, Electrical World
10th Ave. at 36th St., New York City.

ELECTRICAL SUPPLIES

1—300-kw. G. E. Rotary Converter, 25 cy.
1—250-kw. G. E., 230-440 v., 3 ph., 60 cy., dir. conn. to McEwan compound engine.
1—210-kw. G. E., 2300-440 v., 3 ph., 60 cy., dir. conn. to cross compound engine.
6—Westinghouse Induction Alternating Type CCL, 250-hp. Motors, 440 v., 3 ph., 60 cy., speed 514 r.p.m.
1—50-hp. Allis-Chalmers, Induction Motor continuous duty, 440 v., 3 ph., 60 cy., speed 965, 40 deg. Complete with Cutler Hammer starting controller, oil circuit breaker, base, and 14-in. x 9-in. belt pulley.

Send for a free copy of Bulletin No. 205, describing our complete stocks of machinery and equipment.

HARRIS BROS. CO.
35th and Iron Sts., Chicago, Ill.

FOR SALE

ENGINE

1—Buckeye Cross Compound 14 x 24 x 28. also

GENERATOR

1—200 Kw. G. E. Type A.T.B., Form P.A.C., 3 ph., 60 cy., 2300 v., with belted exciter.

Both can be inspected in operation, replacing with larger unit.

Board of Public Works
Water, Light and Sewer Department
City of South Haven, Michigan.

Motor Generator Set

For Immediate Delivery

1—50-kw. G. E. Motor Generator, type DLC, Form 4, 200 amp., 230-v., direct connected to a 75-hp. G. E. Motor, 3 ph., 60 cy., 19 amp., 2200 v., 12000 r.p.m., type I, with Starting Compensator.

Price f.o.b. Jacksonville, Fla. $800.00

1—20-hp. G. E. Motor, type DLC-20, Form A, 230 v., 800 r.p.m., with Slide Rails and Starting Box.

Price f.o.b. Jacksonville, Fla. $200.00

Above in A-1 condition and so guaranteed

Consolidated Engineering Company
215-219 E. Bay Street, Jacksonville, Fla.

Surety Motors

Performance Guarantee Backed by Surety Bond

BONDED

The Motor Man Says—

You can take a used motor, providing you have the equipment, materials and men who know their business, and make it as good as new.

This is exactly what happens to a motor that is renewed up to the standard set before it can carry the Surety Label.

Only good used motors, with no inherent defects, are accepted for renewing. Expert workmen with every modern facility renew them.

Of course, there is a saving in the cost of a Surety Renewed Motor, and the Surety Label guarantees the workmanship, materials and the motor. It must satisfy you. A Bond assures that.

The New Combined Motor List shows a number of additions to the motor stocks of the licensees of the Surety Motor Bonding Co. Write to them for your copy. *MOTOR MAN.*

Duquesne Elec. & Mfg. Co.....6426 Hamilton Ave., Pittsburgh, Pa.
Elliott Electric Co.....813 Superior Ave., N. W., Cleveland, Ohio
Miller-Seldon Electric Co.....1259 Park Pl., Detroit, Mich.
Willey-Wray Electric Co.....118 W. Third St., Cincinnati, Ohio

Surety Motor Bonding Company

SURETY RENEWED MOTORS BONDED — SURETY MOTORS (BONDED)

133 W. Washington St., Chicago, Ill.

Water Tube Boilers

250 to 1000 H.P.—Immediate Delivery!

New Water Tube Boilers, built for pressures of 200 lbs. and 225 lbs., ready for immediate delivery from Chicago, Dumont, New Jersey, opposite New York City, or Slidell, Lousiana, near New Orleans.

Our low prices present a saving of from 25% to 50%. We will take in your old equipment on a liberal exchange basis.

Write for our new catalog fully describing our boilers. Your copy will be mailed on request.

HARRIS BROTHERS COMPANY

West 35th and Iron Sts., Chicago

Motors—Generators

15 kw. Sturtevant 125 volt D.C., 400 r.p.m. generator, direct connected to steam engine.

15 kw. Holtzer-Cabot 125 volt D.C., 650 r.p.m. generator, direct connected to gasoline engine.

Large lot of 110 and 220 volt D.C. motors and generators.

Exceptionally Low Prices on A.C. Equipment. Send Us Your Inquiries.

A. WERBY & CO.
47 Beverly St., Boston, Mass.

Roots Rotary Positive Blowers

5—No. 3 Roots High Pressure, Style D, Blowers, top discharge, with a displacement of 2⅜ cu. ft. per revolution, single geared with double out board bearings on bed plates, 30-in. x 8-in. driving pulleys. Constructed for maximum pressure of 10 lbs. to the sq. inch.

Send for complete specifications

Nashville Industrial Corporation
Jacksonville, Tennessee.

D. C. ENGINE GENERATOR SETS

1—50-kw., 250-v., 280 r.p.m., General Electric, D.C. generator, mounted on sub-base and dir. conn. to 1—11½ x 12 Skinner automat. steam engine, complete with switchboard.

1—100-kw., 250-v., D.C., 250 r.p.m., Bullock cp. wd. generator, dr. conn. to 1—A. L. Ide & Sons, 14 x 14, simple automat. steam engine, complete with switchboard.

1—150-kw., 280 r.p.m., 250-v., D.C., cp. wd., Burke, 3-wire generator set, consisting of 2—75-kw., 125-v., D.C., 280 r.p.m., cp. wd., Burke generators, dir conn to 1—240-hp., 14 x 16 Fleming Harrisburg steam engine, complete with all accessories, including switchboard.

MOTOR GENERATOR SETS

1—100-kw., 250-v., D.C., Gen. Elec., synch. converter with 2200-v., high tension, 3-ph., 60-cy. transformer, complete with switchboard and all accessories.

1—150-kw., 125/250-v., D.C., cp. wd., Westinghouse rotary converter, complete with transformer for 2300-v., high tension, 3-ph., 60-cy., 187-v., low tension, with starting taps, complete with starting equipment and standard D.C. generator panel.

We also carry a large stock of A.C. and D.C. Motors up to 200 HP.

Send Us List of What You Have to Sell

Duquesne Electric & Mfg. Co.
Pittsburgh, Pa.

SURETY RENEWED MOTORS BONDED — SURETY MOTORS (BONDED)

LICENSEES

Willey-Wray Electric Company

SURETY RENEWED GENERATORS

3 Ph. 60 Cy. Alternators

1—37½ kva., 2300 v., 1200 r.p.m. Western, Type ATB with switchboard.
1—90 kva., 230/460 v., 900 r.p.m., Fairbanks-Morse Type AB.
1—135 kva., 240/480 v., 900 r.p.m., G.E., Type ATB.

Direct Current Generators

1—50 kw., 125 v., Jantz & Leist Generator with Ideal Engine.
1—75 kw., 125 v., Jantz & Leist Generator with Ames Engine.

SURETY RENEWED MOTORS BONDED — SURETY MOTORS (BONDED)

LICENSEES
118 W. Third St., Cincinnati, Ohio

Motor Generator Set

SYNCHRONOUS

1—300 kw., 250 v., D.C., 435 hp., 3 ph., 60 cy., 2300 v., G. E. ATI-Form B., Synchronous Motor, Complete Equipment.

"Honestly Rebuilt"

Miller-Owen Electric Co.
Pittsburgh, Penna.

1/6 H. P. Motors

110 v., single phase, 60 cy., 1725 r.p.m., with double end shafts, for immediate delivery.

200 G. E., 145 frame, type S.A. $11.00 each.

175 Westinghouse, 544 frame, type C.A.H. Price $10.50 each.

100 Robbins & Myers, 17 frame, type P, $10.00 each.

250 Ellington, type E.I., frame 62, with single end shaft, $8.50 each.

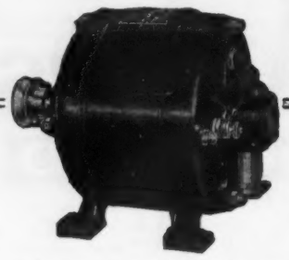
25 Robbins & Myers, 1/6 hp., 220 v., type P, frame 17, with double end shaft, $12.50 each.

50 Robbins & Myers, 1/6 hp., 110 v., 25 cy., single phase, type P, 17 frame, with double end shaft, $12.50 each.

We have dismantled each motor, going over them thoroughly, testing every part, also gave them a coat of paint.

We guarantee every motor listed above

ARRAS EQUIPMENT CORP.
291 Greenwich St., New York, N. Y.
Telephone Barclay 4168.



A Guaranteed Bargain in a Guaranteed Motor

Strictly first-class, 40 deg., 1/6-hp. Motors, developing 2½ times full load. 110 v., 60 cy., 1750 r.p.m. Fully guaranteed.

Also have some bargains in 30, 40 and 50 cy.

WE guarantee if you will compare this 1/6 H.P. Reynolds Motor, specification by specification, with any other motor of similar capacity, you will be convinced that it is the biggest $10 buy in the motor field. Price for single motor $10—less in quantities.

Cancellations are the cause of the low price. The quantity is limited. How many do you need? Write us for price, and get your order in.

1/6 H.P. $10

REYNOLDS ELECTRIC COMPANY 2644 West Congress St. CHICAGO, ILL.

FOR SALE

BOILERS and GENERATING SETS

Surface Condensers

4—Wheeler Condensers, each 2800 sq. ft. surface with water and vacuum pumps.
1—72-in. x 19-ft. 6-in. Keeler return tubular, 157-lb. pressure. Usual fittings.
1—367-hp. Heine water tube, 3669 sq. ft. heating surface, working pressure 180 lb.
4—New 72-in. x 20-ft. triple riveted Keeler return tubulars, 125-lb. pressure; complete boiler fittings.
2—501-hp., Class S, No. 25 Stirling water tube boilers, 160-lb. pressure A.S.M.E.; Detroit stokers, Detrick arches, Foster superheaters.
1—Brand new smokestack, ¼-in. iron, 54-in. dia., 80 ft. high.
2—150-kw. Terry turbos, 2000 r.p.m., condensing, 140-lb. steam pressure, dir. conn. to 125-v., D.C. Crocker-Wheeler generators.
1—50-kw. Bullock turbo, 275 r.p.m., 125-v., dir. conn. Watertown compound engine.
1—500-kw. G. E., 3600 r.p.m., 3ph., 60 cy., 480 v., Curtis turbo unit, condensing.
2—500-kw. Westgh., Bleeder type, new, will build generator to suit.
1—1250-kw. G. E. non-condensing, 600 v., 3 ph., 60 cy.

TECHNICAL ECONOMIST CORP.
2 Rector Street, New York City.
Phone: Whitehall 5243-4

Immediate Delivery

Steam Turbos, 60-cy., 3-ph., etc.

NEW 12,500-kva., 11,500-2300-v. Turbo.
5000-kw., 2300-v. Turbo—80% P.F.
1560 kva., NON-COND., 600-480 v.
250- & 625-kva. Non.-Cond., 240-480-2300 v.
780-kva., 480-2300-v. MIXED PRESS. TURBOS.
800- and 1000-kw., D.C., 250-125-v. Turbo.
1560-1250-625-kva. FREQ. CHANGERS.
400-150-75-50 kw. Eng. Sets, 275 v., D.C.
437-625-kva. SIMPLE CORLISS—240-480-v., 3 ph.
NEW 25 & 35-kw. TURBO EXCITERS, Bargains.
937-kva., 2300-v., 3-ph., 60-cy. Comp. Eng. Set.
2—NEW 1000-hp. STERLING BOILERS, 275 lb.
5—1043-hp. EDGEMOOR BOILERS, 200 lb.
2—400-hp. Edgemoor, 175 lb., with Stokers.
4—NEW 296-hp. B. & W. BOILERS, 200 lb.
NEW 1469-cu. ft., 5320-ft. 2-Stage AIR COMPS.
20—Boiler Feed Pumps, Turbo & Motor drive.
ROCK CRUSHERS, CONTRACTORS' EQUIP., BELTED GEN., ETC. *Send us your inquiries*

ROSS POWER EQUIPMENT CO.
Indianapolis, Ind.

WANTED

WANTED
INDUCTION FEEDER VOLTAGE REGULATOR
1—200 kva., 60 cycle, 2300 volts primary, 230-115 volts secondary, oil immersed, self-cooled, with or without auxiliaries.
ORANGE & ROCKLAND ELECTRIC CO.,
Monroe, N. Y.

300 K. W. 250 Volt D.C. Belted Type 450 R.P.M. 8 Pole Compound Wound Generator

Pedestal Bearings, Commutator ¾ Full

"Honestly Rebuilt"

Miller-Owen Electric Co.
Pittsburgh, Penna.

WANTED
ELECTRIC OVEN
220 v., 3 ph., 7 to 10 kva., size 36 x 40 in.
ELECTRIC MOTOR REPAIR CO.
92 Northern Blvd., Long Island City, N. Y.

WANTED
1 TO 6 OIL SWITCHES
For use on 44,000-v., 3-pole, electrically operated outdoor, preferably G. E., Type K O 26.
VERMONT HYDRO ELECTRIC CORP.
Rutland, Vermont.

FOR SALE

160 K. W. Engine Drive Exciter

1—160 Kw., 125 v., 230 r.p.m. General Electric Type M.P. form L direct current generator mounted on common bed plate with and direct connected to Phoenix 14½ x 15 engine good for 150 to 190 pounds steam pressure.

Set now in use being removed to provide space for dual drive set.

FS-470, Electrical World
1570 Old Colony Bldg., Chicago, Ill.

POWER PLANT

Complete power plant, consisting of Two (2) Used Curtis Turbine General Electric Generator Sets, 600 kw. Unit each, 2300 volts A.C. with Exciters, Transformers, Switch Boards, etc.

3—500 hp. Keeler Water Tube Boilers, complete with Stokers, Soot Blowers, Ash Conveyors, Feed Water Heater, Condensing equipment and spray for cooling.

In excellent condition at an exceptional price.

Crawford Machinery Co.
1201 House Bldg., Pittsburgh, Pa.

WANTED
TRANSFORMERS
One or two 25 kw., 2300 volt, 60 cycle, 6.6 ampere, constant current, indoor type. Must be in first class condition and of G. E. or Westinghouse manufacture. Mail complete information with price to
VIRGINIA-WESTERN POWER COMPANY.
Clifton Forge, Va.

Rebuilt and New Electric Motors, Generators and Transformers

All standard makes, sold, bought and exchanged. Our rebuilt motors stand every test of new motors; 8000 always in stock; send for stock list. Write what you want or have to sell.

FUERST-FRIEDMAN CO., Cleveland, Ohio.

In Trouble
MOTORS RENTED
Any size or kind up to 550-hp. Largest stock of its kind in America
NATHAN KLEIN & CO.
208 Centre St., N. Y.

Notice to Advertisers

Owing to the holiday—New Years—the *"Searchlight"* pages of January 6th issue of *Electrical World* will close for press earlier than usual. Copy should reach us as follows.

Display Ads—Copy required by 10 A.M., Saturday, December 30th.

Want Ads—Copy required by 10 A. M., Tuesday, January 2nd.

SEARCHLIGHT SECTION

EMPLOYMENT-BUSINESS OPPORTUNITIES-EQUIPMENT

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.

Positions Vacant and all other classifications, 8 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 to 3 inches.....$5.00 an inch
4 to 7 inches..... 4.80 an inch
8 to 15 inches..... 4.60 an inch

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

E.W.

POSITIONS VACANT

BILLING and ledger clerk; salary $150 per month. State experience and references in first letter. Virginia Western Power Co., Clifton Forge, Va.

ELECTRICAL Designer experienced in power and substation design. Permanent position and chances for advancement with large power company. State age, education, experience and salary expected in first letter. Location New York State. P-425, Elec. World, 10th Ave. at 36th St., New York City.

ELECTRICAL engineer wanted for Western New York public utility who is familiar with power and sub-station design for interior layout of electrical apparatus in proposed new power plants and substations. State age, education, experience and salary expected. P-466, Elec. World, 10th Ave. at 36th St., New York City.

ELECTRICAL engineer, with experience on power plant, electrical equipment, substations and transmission lines for construction design work and technical problems connected with the operation of a large public utility system. Technical ability together with experience on similar work necessary. Replies must give details of education, experience, personal characteristics, references and salary desired. Send photograph if possible. P-465, Elec. World, Leader-News Bldg., Cleveland, Ohio.

ELECTRICIAN wanted—Head electrician for manufacturing plant located in Central New York State. Main plant operated by steam; about 5,000 rated horse power in small and medium size motors, 440 volt A.C., 3 phase, 60 cycle, cranes 110 volts D.C., lighting, 110 volt A.C. Also electrical recording and controlling instruments. Steady job with advancement for right man. Reply stating experience, age, etc. P-467, Elec. World, 10th Ave. at 36th St., New York City.

ELECTRICIANS wanted for power construction, switchboard, remote control, and bus bar construction in New Jersey. Apply, giving experience and wages earned previously. P-427, Elec. World, 10th Ave. at 36th St., New York.

EXECUTIVE for electric light and power utility serving population of about 50,000, experienced in operation, construction and public relations. Must possess initiative, ambition, imagination, ability to recognize and willingness to shoulder responsibility and merit rapid promotion. Location, Middle Atlantic States. In reply state fully education, past experience, present salary and salary expected. P-442, Elec. World, Real Estate Trust Bldg., Phila., Pa.

FIRST-CLASS all-round electrician wanted, capable of rewinding all kinds of motors and armatures; repairing and rebuilding of all kinds of commutators; shooting trouble on all kinds of electrical apparatus. Must have had not less than five years' experience in small jobbing shop where every kind and class of electrical work is done; necessary technical education; between the ages of 25 and 35; fast and accurate worker. References required for past 10 years. Wages $8.00 per day with opportunity for advancement. Hambrick Electric Co., 1502 E. Front St., Fort Worth, Texas.

WANTED

Electrical Engineer

Young graduate engineer to specialize in testing of incandescent lamps. Write

ELECTRICAL TESTING LABORATORIES
80th St. and East End Ave., New York City.

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
509 Real Estate Trust Bldg., Phila.
533 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
531 Rialto Bldg., San Francisco.

Important

Original letters of recommendations or other papers of value should not be enclosed to unknown correspondents — send copies.

0195

POSITIONS VACANT

GRADUATE electrical engineer wanted by large street railway in eastern Pennsylvania for manager's office; should be about thirty years of age, experienced thoroughly in street railway motors, feeder lines and substations; preferably a man with shop experience. P-454, Elec. World, Real Estate Trust Bldg., Philadelphia, Pa.

LARGE Central Station in middle west requires services of technical graduates in mechanical and electrical engineering. Give outline of education in first reply. Experience not necessary. P-417, Elec. World, Old Colony Bldg., Chicago, Ill.

METERMAN wanted for testing and installing single and polyphase watt-hour meters. In reply, state age, experience and salary desired. References required; location northern West Virginia. P-461, Elec. World, Leader-News Bldg., Cleveland, Ohio.

RADIO engineer wanted by large electrical manufacturing company. Applicant should be technical college graduate in electrical engineering, with experience in experimental radio development problems involving both transmitting and receiving. None but high grade development engineers need apply. State age, education and experience. Address P-988, Elec. World.

REPAIR shop foreman, a thoroughly first-class man to assume charge of our electrical repairs department operating fifteen men. Must be fully experienced and practical man competent to operate shop along modern lines. None considered except those holding or having held position as shop foreman or assistant foreman in some good, recognized repair shop. position is absolutely permanent with good prospects for advancement to the right man. Kindly reply, giving in your first letter age, experience, salary expected and how soon you can report for work. The Electric Service Company, 212 Walnut Street, Cincinnati, O.

POSITIONS VACANT

TWO experienced armature winders wanted for A.C. and D.C. work in a large industrial plant located in central Pennsylvania. One sub-station operator, experienced in high tension switching and the operation of rotary converters and motor generator sets. Give full information in reply. P-459, Elec. World, Real Estate Trust Bldg., Philadelphia, Pa.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000 upward; executive, technical, administrative, engineering, manufacturing, professional, managing, financial, etc., all lines. If you are qualified and receptive to tentative offers for a new connection, you are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions. A method is provided through which you may receive overtures in confidence without jeopardizing present connections and in a manner conforming strictly to professional ethics. Send name and address only. Preliminary particulars will be sent without obligating or compromising you in any way. R. W. Bixby, Inc., 410 Lockwood Bldg., Buffalo, N. Y.

POSITIONS WANTED

ACCOUNTANT, auditor, thoroughly competent, twenty years' experience electric, gas, water and street railway. Go anywhere. Address PW-430, Elec. World, 10th Ave. at 36th St., New York City.

AS GENERAL line foreman, American, married, now with large corporation, wishes to make change. Have had 20 years' practical experience, 15 years of that time having full charge electrical construction and maintenance department; available within 30 days. PW-446, Elec. World, 10th Ave. at 36th St., New York City.

AS LINE foreman, first class electric light or trolley construction and maintenance man; can take full charge electric distribution or construction department; married. Only regular maintenance job considered. PW-458, Elec. World, Real Estate Trust Bldg., Philadelphia, Pa.

AS RAILWAY substation operator by an ambitious student of the International Correspondence Schools; at present employed; age twenty-two, married. PW-457, Elec. World, Leader-News Bldg., Cleveland, Ohio.

EXECUTIVES

Qualified men—Technical, Commercial and Manufacturing—seeking new positions find our effective and confidential service extremely satisfactory. Our Mr. H. H. Harrison can negotiate a suitable connection for you as he has done for thousands of others since 1909. Inquiries invited; confidences respected.

THE NATIONAL BUSINESS BOURSE, Inc.
Confidential Negotiators
Association Building, Chicago

BE A METER ENGINEER

Get in the new profession. We can teach you meter engineering *by mail* at your own home during spare time. Successful graduates everywhere.

Earn $3,600.00 a Year.

Central stations *must have Electrical Meter Engineers.* They pay high salaries. *Write today.* Just your name and address on a postal and we will send you full particulars free. Ft. Wayne Correspondence School, Dept. 46, Ft. Wayne, Ind.

POSITIONS WANTED

AUDITOR. Broad experience as chief accounting officer with representative utility interests, now engaged on important work for Federal Government, desires connection with progressive utility, as auditor, secretary or treasurer. PW-419, Elec. World, Real Estate Trust Bldg., Phila., Pa.

BY YOUNG married man; technical education; ten years' experience on line, sub and central station, construction steam and hydro; will go anywhere. PW-469, Elec. World, 10th Ave. at 36th St., New York City.

ELECTRICAL engineer and executive, married; age thirty-three; seven years' experience in power plant engineering, design, construction and sales; best of references; available 30 days; minimum salary $3,300. PW-460, Elec. World, Old Colony Bldg., Chicago, Ill.

ELECTRICAL foreman, in charge installation and operation substations, mining and milling equipment, industrial motors, available after Jan. 1; age thirty, single; references to any past employer. PW-456, Elec. World, Rialto Bldg., San Francisco, Calif.

GRADUATE mechanical engineer, thirty-four years old, with good operating, construction and executive experience desires position as superintendent of power, or mechanical superintendent in medium sized works; or that will lead to similar position in large company. Would consider public utility. Assoc. Mem. A. S. M. E. Northeast preferred. PW-426, Elec. World, Real Estate Trust Bldg., Phila., Pa.

POSITIONS WANTED

EXECUTIVE with initiative, tact and proved administrative ability solicits correspondence; 20 years with some of most progressive gas and electric organizations in America and hence in touch with most approved practice in both fields. Special studies and extended experience in advertising, publicity, organization, systematizing, salesmanship, managing sales campaigns, contract drafting, rate designing, cost analysis, security sales and plant management. Also familiar with utility commission practice. Character, record and references an "open book." PW-468, Elec. World., 10th Ave. at 36th St., New York City.

SALES engineer and executive, thirty-two, technical training, available Jan. 1; fourteen years' experience on manufacturing, statistics and selling batteries, railway electric equipment, electric motors and generators and machine tools; good merchandiser and salary secondary item. PW-462, Elec. World, 10th Ave. at 36th St., New York City.

SUPERINTENDENT Public Utilities; technical, 20 years installing and operating various station equipments, railway, electric, water and gas utilities. PW-421, Elec. World, Old Colony Bldg., Chicago, Ill.

REPRESENTATIVES WANTED

New England District Representative

A responsible long established firm making a complete line of direct and alternating current control apparatus wants an active experienced salesman as representative in the New England territory with headquarters in Boston. Position offers permanent connection with very good opportunities. RW-441, Elec. World, Old Colony Bldg., Chicago, Ill.

EDUCATIONAL

Keystone Institute

"The service school." A fully equipped school organized to give intensive instruction in 2-year courses electrical engineering, mechanical engineering, accounting and business administration, 16 weeks' course in automotive engineering. Day and night classes. Graduates sought by industrial establishments in all sections of country. Write for information on subject that interests you, to Keystone Institute. Address Associate Principal, 133 North 4th Street, Reading, Penn.

FOR SALE

An exceptional opportunity is offered to acquire the

Completely Equipped Plant and Good Will of an Established Electrical Manufacturing Company

with a national reputation for making the highest grade of product, and known to practically every large public service company in the country.

The entire business may be purchased outright or a portion of the capital stock.

Address: BO-471, Electrical World, 10th Ave. and 36th St., New York.

Make Replaced Equipment Help Pay For The New

Engines
Generators
Motors
Transformers
Boilers
Transmission Equipment
Pumps
etc. etc.
Single items or complete plants

You can find quick buyers for your replaced equipment, if it still is in good operating condition, through the

Searchlight Section of Electrical World

Careful buyers recognize that the *Searchlight Section* is the best medium for locating good used equipment of all kinds.

Let "Searchlight" Help You

EW-1

INVESTMENT BANKERS are offered POWER and LIGHT SECURITIES

issued by companies with long records of substantial earnings.

We extend the facilities of our organization to those desiring detailed information or reports on any of the companies with which we are identified.

ELECTRIC BOND AND SHARE COMPANY

(Paid-up Capital and Surplus, $29,000,000)

71 Broadway, New York

Public Utility and Industrial Financing

SECURITY issues of Public Utility and Industrial companies underwritten and distributed in any amount. We are pleased to consult with established companies requiring money for the purpose of expansion, the acquisition of new properties or the reduction of obligations. Address correspondence to Mr. Burton French.

HOAGLAND, ALLUM & CO.

Incorporated
(*Established* 1909)

NEW YORK, 115 Broadway — 14 So. La Salle St., CHICAGO

Utility and Industrial Financing

We underwrite and distribute securities in any amounts on the properties of public utility and industrial corporations. Our extensive facilities insure promptness and complete service.

Ray & Company, Inc.

108 South La Salle St. — Chicago, Ill.

PUBLIC UTILITY and Industrial Financing

companies will find that their advertisements in the pages of the Electrical World reach a responsive reader.

The

COAL & IRON NATIONAL BANK

143 Liberty Street
New York

Capital and Surplus
$2,500,000.00

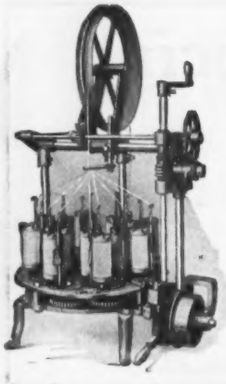
Member
N. Y. Clearing House
Federal Reserve Bank

"Buy It Of Belden"
Is a good one for Wire Users

Belden
Manufacturing Company
Electrical Wire, Cable and Cordage
2300 South Western Avenue
Chicago
Magnet Wire and Tape Departments
4625 West Vanburen Street
Chicago
Eastern Office and Warehouse, Metuchen, N. J.

Americore
RUBBER COVERED WIRE
for INTERIOR WIRING
Highest Standard of Excellence
Send for descriptive book
American Steel & Wire Company
Chicago - New York

Uniform Gauge
of Enamel or Cotton Insulation.
Thorough Inspection
Each spool carries an individual inspection number.
Shipment from Stock
Quick delivery of American Magnet Wire is assured. Write for prices.
The American Enameled Magnet Wire Co.,
Muskegon, Mich.



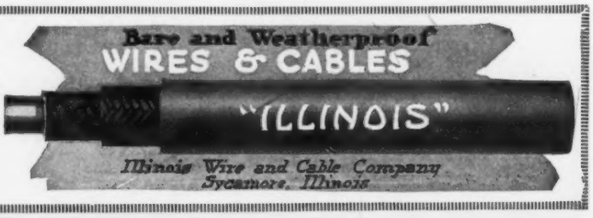
Braiding Machinery
For Covering Wires
Machinery
for
INSULATING
Wires and Cables
With Rubber or Tape
Cabling, Stranding, Twinning, Polishing, Taping, Winding and Measuring Machines.
New England Butt Co.
Providence, R. I.

SEAMLESS RUBBER SAFETY INSULATIONS
SAFETY INSULATED WIRE & CABLE CO.
114 Liberty Street. NEW YORK
CHICAGO BOSTON
SAN FRANCISCO

ANACONDA
Copper Wire
111 W. Washington St., Chicago

INTERIOR CONDUITS
American Circular Loom Co.
90 West Street
New York
AMERICAN CIRCULAR LOOM CO. TRADE MARK
Boston Los Angeles Seattle
Chicago San Francisco Toronto

SILK
For Electrical Purposes
Silk for Insulating Finest Wire
ALL KINDS BRAIDING SILK
William Ryle & Co., 225 Fourth Ave., Cor. 18th St. New York City

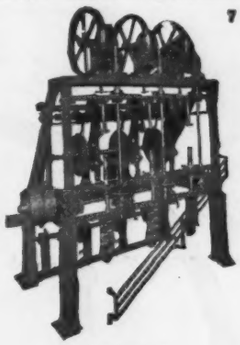


EST. 1885 AIMCo INC. 1918
"American" INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
PHILADELPHIA PENNSYLVANIA U.S.A.

MACHINES FOR

DRAWING	PANNING
MEASURING	VULCANIZING
RESPOOLING	TAPING
SATURATING	TWINNING
RECLAIMING	CABLING
ENAMELING	STRANDING
INSULATING	

OF WIRE



Single Cover TAPING MACHINE for 3 Lines of Wire.

"American Brand"

Weatherproof Wire and Cables,
Bare Copper Wire and Cables

has no equal for long, satisfactory economical service.

American Insulated Wire and Cable Co.
21st, Sangamon and Morgan Sts., Chicago

DUDLO Magnet Wire and Windings

DUDLO

have for over twelve years been standard among electrical manufacturers due to their dependable quality and reasonable price. Find out the economy and improvement we can effect for you.

Write today for prices and samples.

Dudlo Manufacturing Company, Fort Wayne, Indiana

ARISTOS
"COPPERWELD"
TRADE MARK REG. U.S. PAT. OFF.
MADE BY THE MOLTEN WELDING PROCESS

WIRE and STRAND
(Bare and Weatherproof)
TWISTED PAIR
GROUND RODS
NAILS

Technical data and Wire Tables on request.

COPPER CLAD STEEL COMPANY
NEW YORK SALES OFFICE 30 CHURCH STREET, NEW YORK
CHICAGO SALES OFFICE 129 S. JEFFERSON ST., CHICAGO
MAIN OFFICE AND WORKS BRADDOCK P.O. RANKIN, PA.

Note Protection at Corners

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

Blake Signal & Mfg. Co.
Boston, Mass.

VULCANIZED FIBRE

Be Sure to Specify
"Wilmington Fibre"
Sheets Rods Tubes
Special Shapes for Insulation Purposes
"FYBEROID"

Wilmington Fibre Specialty Company
Wilmington, Del. Branch Offices "Everywhere"

Calido is the *life* of the electric appliance

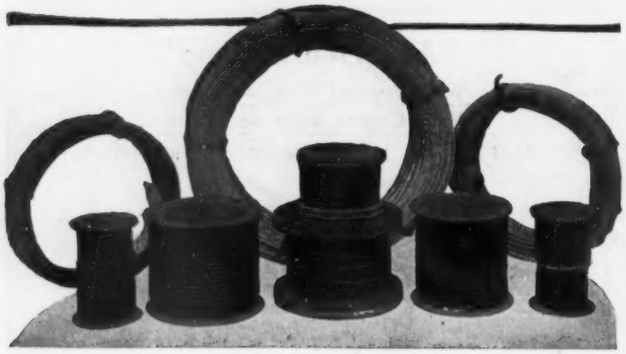
ELECTRICAL ALLOY CO. MORRISTOWN, N.J.

Electrical Wires and Cables Welding Wire

John A. Roebling's Sons Co., Trenton, N. J.

STANDARD

Wires, Cables, Cable Accessories
Superior quality, economical prices
Standard Underground Cable Co.
Boston Philadelphia Pittsburgh Detroit
New York Washington Chicago St. Louis
San Francisco



Deltabeston Asbestos Wire Assures Continuous Service

The use of a heatproof conductor with appliances and fixtures, which radiate an appreciable amount of heat, is very important.

Colorbeston fixture wires withstand the heat of high wattage, gas filled lamps without charring. They slide readily and the insulation will not peel or unravel. Colorbeston wires are made in six colors to match standard fixture finishes.

Deterioration of wiring and leads is also prevented by using Deltabeston wires and cable on electric ranges, flatirons, percolators and other household and industrial heating devices.

Years of successful operation may be expected when overloaded motors are repaired by means of Deltabeston Magnet Wire. The asbestos insulation assures continuity of service under abnormal conditions.

For locomotive headlight and cab wiring Deltabeston wires are giving continuous satisfaction on many roads.

A catalog explaining the various types and applications of Deltabeston Wires will be mailed upon request.

Wire Division
of General Electric Company
Schenectady, N.Y.

DWD-50X

MARING PROCESS

Magnet Wires
Enameled Cotton Silk

MARING WIRE COMPANY
Muskegon, Mich.

Durability

Virtually indestructible solidarity of the whole mass is a characteristic of our coils because of their even alignment, absolute insulation and the high coefficient of expansion and contraction.

The Coto-Coil Co.
Providence, R. I.

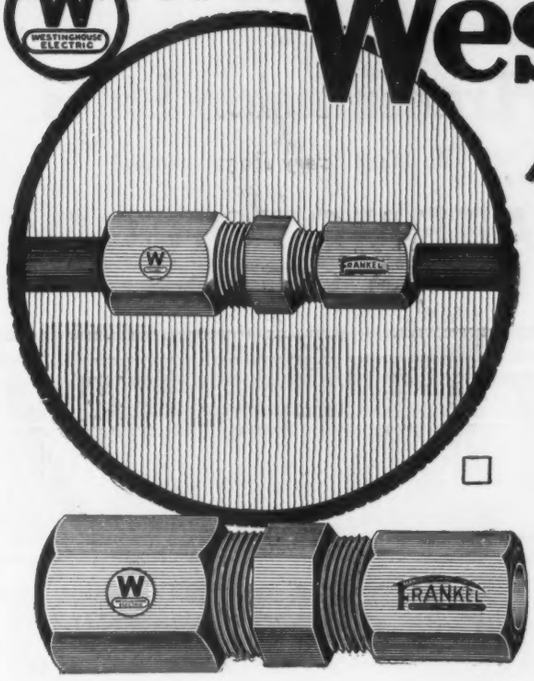
S-S
TRADE MARK

Superiority of
Super-Seasoned Fibre
is due to thorough seasoning
See our page advertisements in other issues.
Send for the "Super-Seasoned Fibre" book.
National Fibre & Insulation Co.
Box 389, Wilmington, Delaware

ELECTRICAL CONDUITS AND FITTINGS
— WRITE FOR BULLETINS —
National Metal Molding Co.
PITTSBURGH, PA.

Westinghouse -Frankel

SOLDERLESS REDUCERS



IF you want to connect a solid with a stranded conductor—each with different diameters—the Westinghouse-Frankel Reducer is the economical answer because it is quickly done.

There is no overheating at the joint as the conducticity is greater there than in the conductors themselves.

There are very few connections you'll ever want to make with solder once you use the Westinghouse-Frankel connector with compression grip.

The possibilities for economy in using this type of connector and other valuable information will be sent you upon request.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
EAST PITTSBURGH . . PENNSYLVANIA

4X 61724

Sherman Soldering Lugs

U. S. Patent Reissue 14401

Approved

WE have created a standard line of soldering lugs, making it unnecessary for people to use any old kind of lugs that they can get, or make their own.

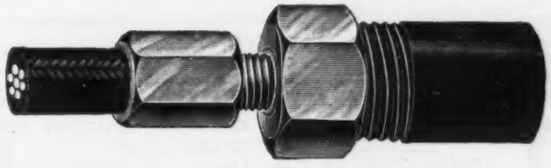
A standard line that is absolutely efficient and rightly priced.

Sherman Soldering Lugs are marked with the N. E. C. rating in amperes across the flat portion at the wire end. This guarantees "approved" lugs.

Full particulars will be furnished on request.

H. B. Sherman Mfg. Company
Battle Creek, Michigan

This is the way to connect ground wires to the end of a pipe



DOSSERT GROUNDING CAP

(Solderless)

Simply another way of using the Dossert Tapered Sleeve principle to simplify the work and to promote efficiency.

The fifteenth year book gives you many suggestions on good wiring methods.

GET THIS BOOK

FREE

Dossert & Co.
242 West 41st Street
New York, N. Y.

Naugle

SERVICE gratifies
PRICE satisfies
QUALITY identifies

Northern and Western Cedar
Plain or butt-treated
We PENTREX treat—½ inch
penetration guaranteed

Naugle Pole & Tie Co.
5 South Wabash Ave., Chicago, Ill.

BRANCHES:
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MAIN YARDS:
•Chicago, •Pinconning, Mich., Green Bay, Wis.
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STEEL STRUCTURES
for
Transmission Lines
To Meet Every Requirement
AERMOTOR CO.
Chicago

Steel Transmission Towers
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RAILWAY AND INDUSTRIAL ENGINEERING COMPANY
TRANSMISSION SWITCHING AND PROTECTIVE EQUIPMENT-
DISTRICT- PITTSBURGH, OFFICES: NEW YORK - CHICAGO.
GREENSBURG, PA.

CEDAR POLES
Northern White Cedar
Western Red Cedar
Plain or treated Butts
Prompt shipments guaranteed. Ask for delivered prices
T. M. PARTRIDGE LUMBER CO.
Pole Department, Lumber Exchange, Minneapolis, Minn.

Transmission Line and Special Crossing Structures, Catenary Bridges
WRITE FOR OUR NEW DESCRIPTIVE CATALOG.
ARCHBOLD-BRADY CO.
Engineers and Contractors SYRACUSE, N. Y.

BELL
NORTHERN **CEDAR POLES** WESTERN
BUTT TREATING ANY KIND REQUIRED
PACIFIC FIR CO. *WESTERN* POLES.
BELL LUMBER CO., *Minneapolis, Minn.*

Lapp Insulators
Lapp Insulator Co. Inc. LeRoy, N.Y.
Trade Mark

The Valentine-Clark Co.
CEDAR POLES
New York Toledo Chicago
Minneapolis Spokane
Specify V-C Butt Preservation.
This guarantees you a perfect Process of Pole Butt Preservation.

Milliken
Radio and Transmission Towers
Milliken Brothers Mfg. Co., Inc.
Woolworth Bldg. New York

RUGGED DISC INSULATORS
PROTECT WITH JD TO A GREATER DEGREE."
JEFFERY-DEWITT INSULATOR CO. KENOVA, W. VA. U.S.A.
THICKER PORCELAIN FOR POWER TRANSMISSION SERVICE.

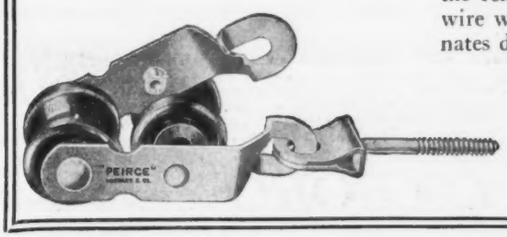
PORCELAIN INSULATORS
for in the station and on the line
TIME IS THE TEST
The OHIO BRASS Co., Mansfield, Ohio

A Perfect Tree Insulator should provide:

1. Sufficient insulation
2. An easy method of installation without injury to the tree
3. An easy method of stringing in the line without cutting
4. A roller bearing to prevent chafing the insulation
5. Sufficient strength and flexibility for use with various sizes of wire

No. 2934

The Peirce Tree Fixture with one side detached showing simplicity of construction.



The Peirce Tree Fixture

embodies all these requirements. The Sister Hook feature permits the removal of insulators for driving the screw and stringing in the wire without the usual trouble with small nuts and bolts, also eliminates danger of parts working loose due to vibration.

—ask your Jobber

HUBBARD & COMPANY
Pittsburgh—Chicago

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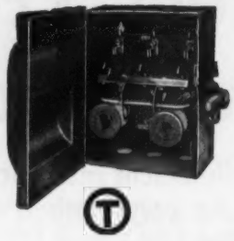

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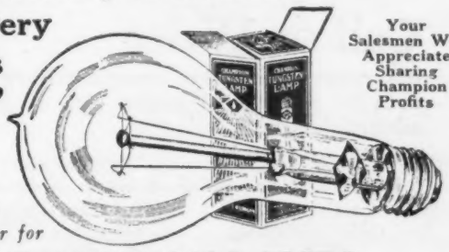

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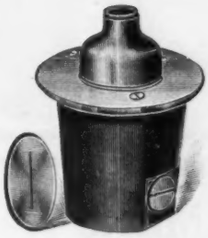

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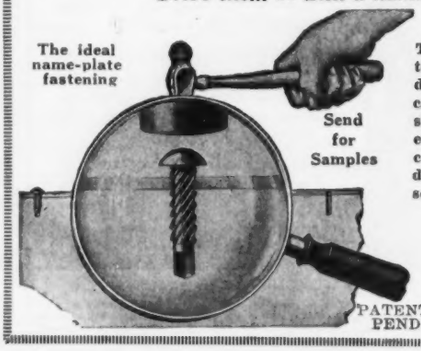

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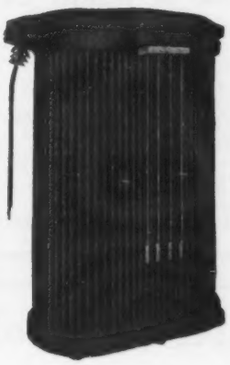

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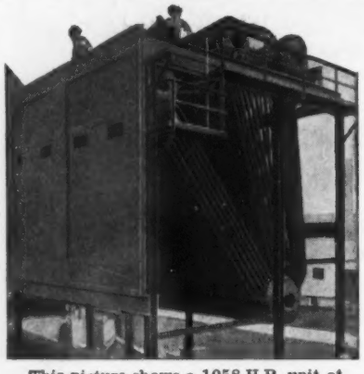

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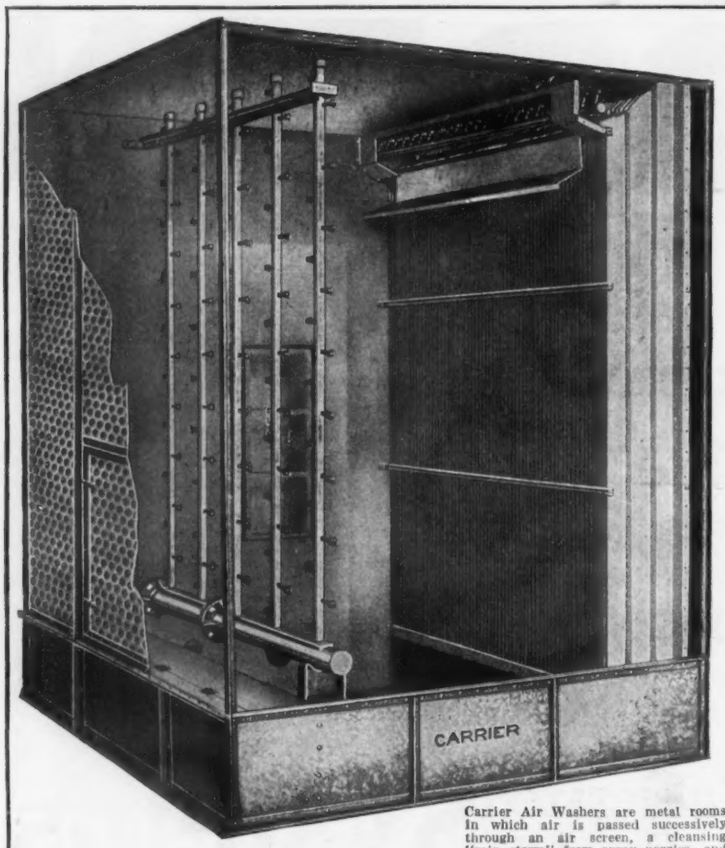

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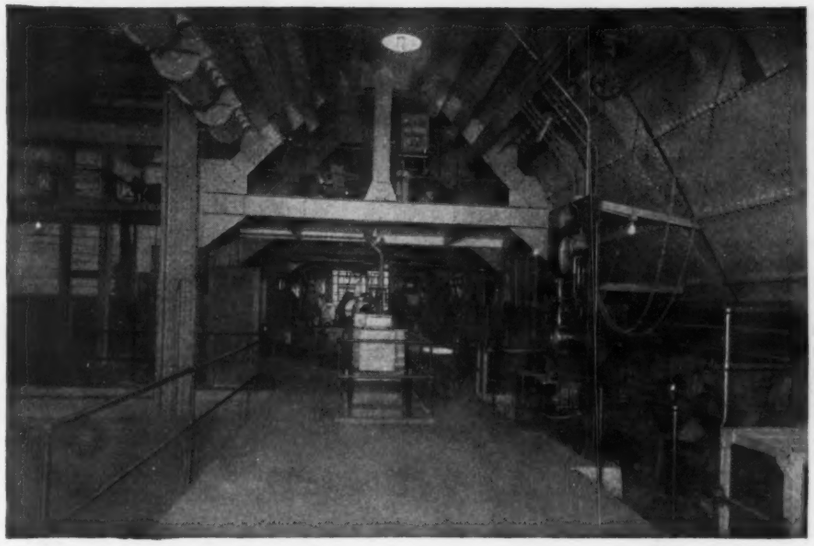

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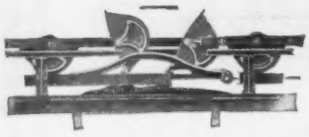

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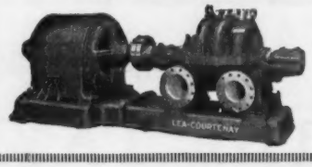

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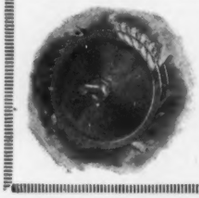

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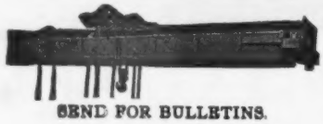

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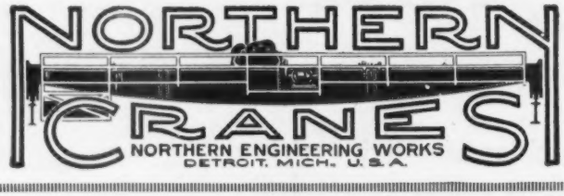

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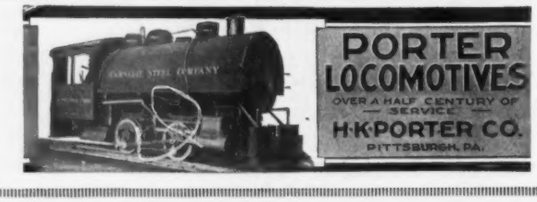

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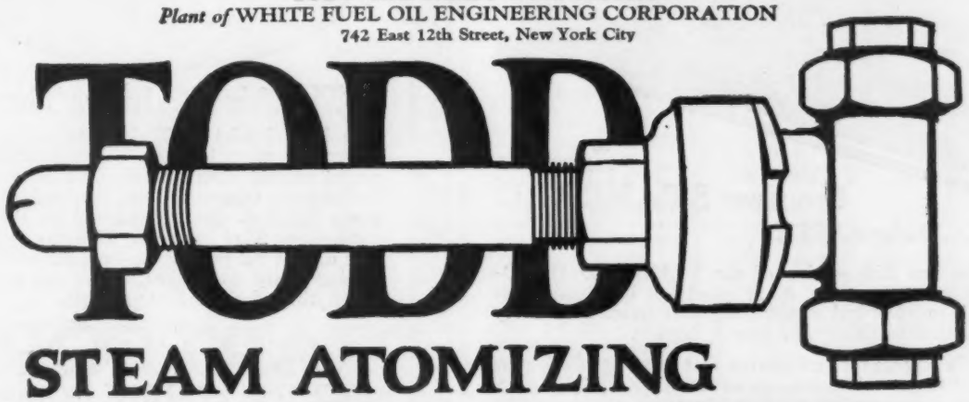

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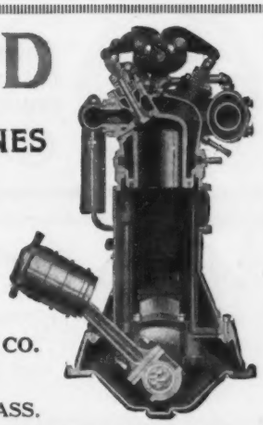

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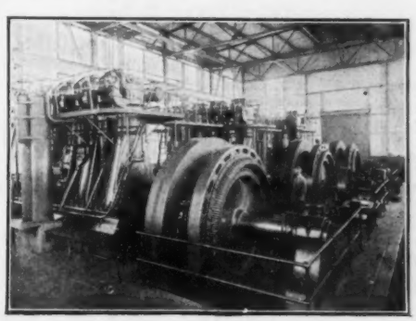

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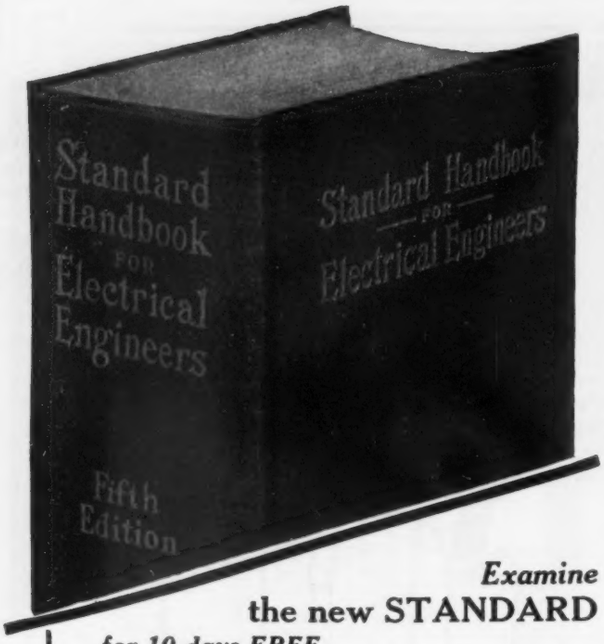

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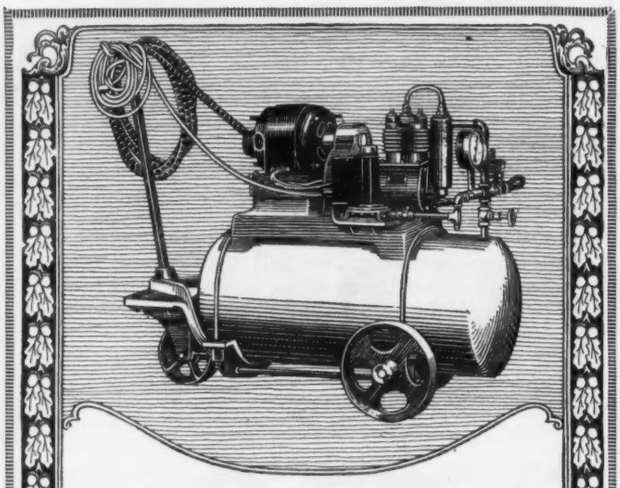

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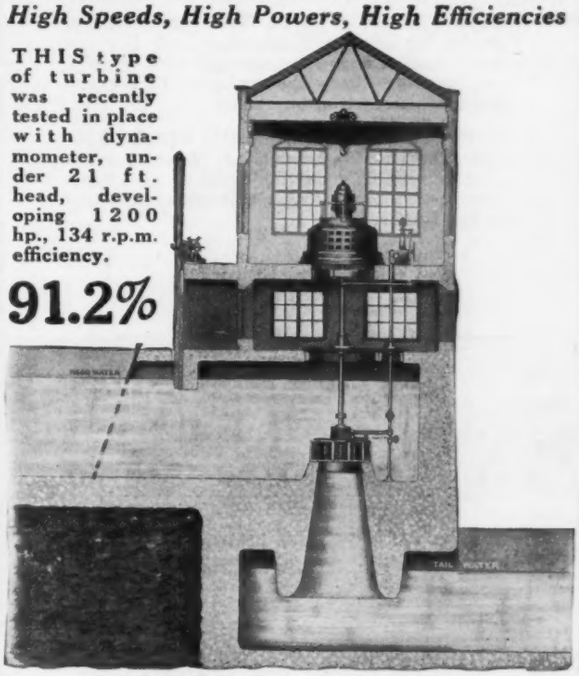

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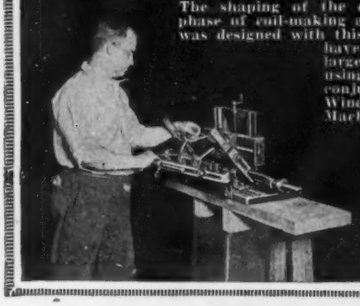

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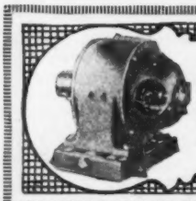

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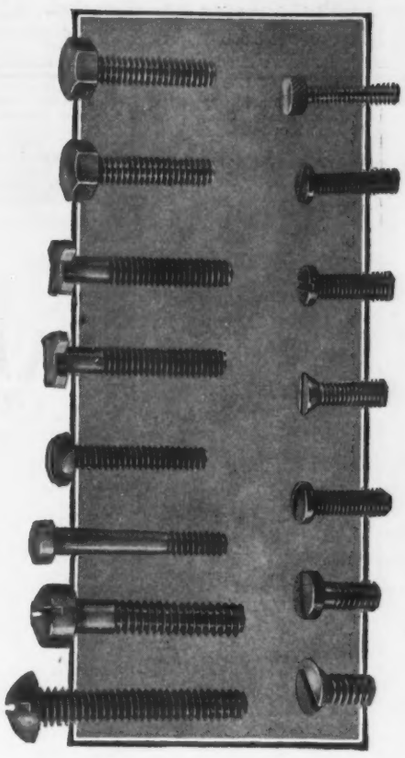

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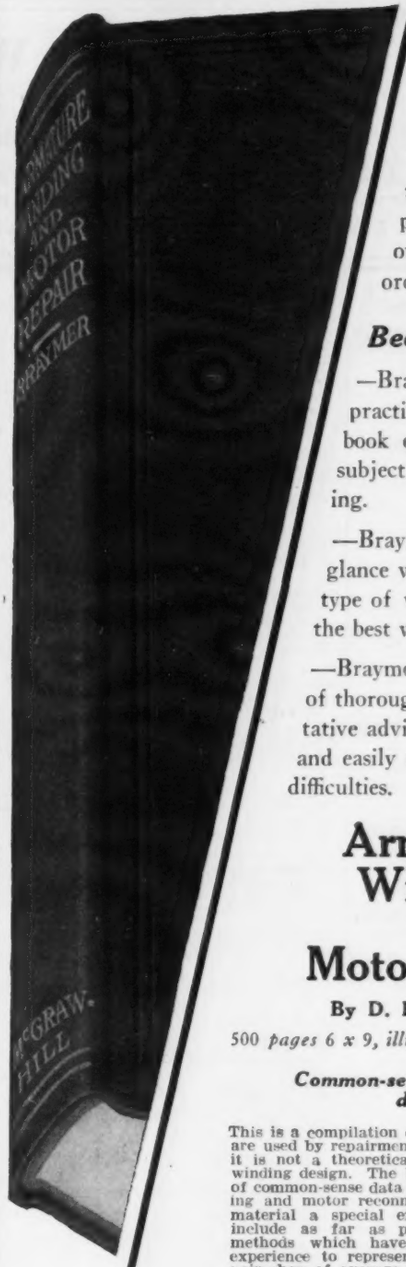

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Elec. Service Supplies Co.

Coils, Armature, Field and Magnet
Coto-Coil Co.
Dudlo Mfg. Co.
General Electric Co.
Industrial Controller Co.
I. R. Nelson Co.

Coils, Choke
Delta Star Elec. Co.
General Electric Co.
Hi-Voltage Equip. Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Columns, Safety Water
Lunkenheimer Co.

Commutators
Cameron Elec. Mfg. Co.

Condensation Products
Bakelite Corporation
Condensite Co. of America
General Bakelite Co.
Redmanol Chem. Prod. Co.

Condensers
Steam
Allis-Chalmers Mfg. Co.
Elliott Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Condensers, Rotary Jet
Manistee Iron Works

Conduit Fittings
Chicago Fuse Mfg. Co.

Conduit
Interior
American Circular Loom Company
National Metal Molding Co.

Connectors and Terminals
Dossert & Co.
Electric Power Equip. Corp.
Frankel Connector Co.
General Electric Co.
Sherman Mfg. Co., H. B.
Westinghouse Elec. & Mfg. Co.

Construction Engineering (See Directory of Engineers)

Contact Rail Material
Electric Service Supplies Co.

Controllers
Electric Automatic
Ward Leonard Electric Co.
Motor
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery (Coal, Ashes, Etc.)
Gifford-Wood Co.

Cooling Ponds, Spray
Spray Engineering Co.

Cord Adjusters
National Fibre & Ins. Co.

Cord
Arc Lamp
Samson Cordage Works
Flexible
Indiana Rubber & Ins. Wire Co.
Rome Wire Co.
Trolley
Samson Cordage Co.

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Smith & Serrell

Couplings, Rigid Shaft
Smith & Serrell

Crane Motors
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Cranes
Traveling
Maris Bros.
Northern Eng'g Works

Cross Arms
Hubbard & Co.
Railway & Industrial Eng. Co.
Western Electric Co.

Crushers, Coal and Coke
Gifford-Wood Co.

Cups, Oil and Grease
Lunkenheimer Co.

Cutouts
Chicago Fuse Mfg. Co.
G & W Elec. Spec. Co.
General Electric Co.
Metropolitan Device Corp.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Deaerators
Elliott Co.

Dies, Cutting
Bliss Co., E. W.

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Electrical Development & Mach. Co.

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Brick
Hubbard & Co.

Electromagnets
Coto-Coil Co., The

Elevators, Coal
Gifford-Wood Co.

Engineers, Consulting and Contracting
(See Directory of Engineers)

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Lunkenheimer Co.

Engines
Diesel
Busch-Sulzer Bros. Diesel Eng. Co.
Lombard Governor Co.
Internal Combustion
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
McIntosh & Seymour Corp.
Oil
Busch-Sulzer Bros. Diesel Eng. Co.
Lombard Governor Co.
Steam
Allis-Chalmers Mfg. Co.

Excavating Machinery, Motor Driven
Hayward Co.

Experimental Apparatus
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.

Factory Equipment, Steel
Lupton's Sons Co., David

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Century Electric Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
General Electric Co.
Peerless Electric Co.
Robbins & Myers Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Allis Co., Louis
Buffalo Forge Co.
Century Electric Co.
Diehl Mfg. Co.
General Electric Co.
Kimble Elec. Co.
Robbins & Myers Co.
Westinghouse Elec. & Mfg Co.

Fans, Turbine Driven
Terry Steam Turbine Co.

Fibre (See Insulating Material)

Financial
Coal & Iron National Bank
Electric Bond & Share Co.
Hoagland Allum Co.
Ray & Company

Fire Alarms
Ostrander & Co., W. R.

Fire Brick
Celite Products Co.

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Grating
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Metallic
Irving Iron Works Co.

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Green Eng. Co.

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Detroit Electric Furnace Co.
Pittsburgh Elec. Furnace Corp.
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Combustion Engr. Co.

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Delta-Star Electric Co.

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High Tension
Delta-Star Electric Co.
Elec. Engineers Equip. Co.
Schweitzer & Conrad, Inc.
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Chicago Fuse Mfg. Co.
Renewable
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Chicago Fuse Mfg. Co.
Electrical Development & Mach. Co.
Metropolitan Device Corp.
Western Electric Co.
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Foxboro Co., The

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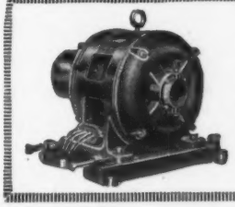
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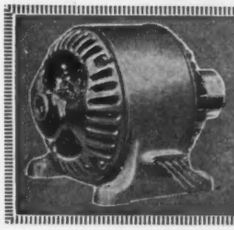
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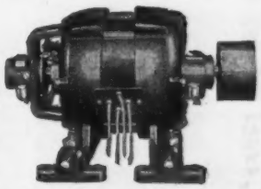
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Shelton Elec. Co.

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Western Electric Co.
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Allis-Chalmers Mfg. Co.

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Green Engr. Co.

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Roller-Smith Co.

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Roller-Smith Co.
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General Electric Co.
Spray Engineering Co.
Westinghouse Elec. & Mfg. Co.
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Bristol Co., The
General Electric Co.
Westinghouse Elec. & Mfg. Co.
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Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
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Biddle, James G.
Duncan Elec. Mfg. Co.
General Electric Co.
Roller-Smith Co.
Sewickley Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
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Metropolitan Device Corp.
Roller-Smith Co.
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Redmanol Chem. Prod. Co.
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Mica Insulator Co.
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Garfield Mfg. Co.
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Irvington Varnish & Ins. Co.
Mica Insulator Co.
Packard Electric Co.
Redmanol Chem. Prod. Co.
Sterling Varnish Co.
Westinghouse Elec. & Mfg. Co.
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Diamond State Fibre Co.
National Fibre & Ins. Co.
Lava
American Lava Co.
Steward Mfg. Co., D. M.
Mica
Mica Insulator Co.
Molded
Bakelite Corporation
Belden Mfg. Co.
Condensite Co. of America
General Bakelite Co.
Garfield Mfg. Co.
Redmanol Chem. Prod. Co.
Paper
Diamond State Fibre Co.
Irvington Varnish & Ins. Co.
National Fibre & Ins. Co.
Porcelain
Louthan Mfg. Co.
Silk
Irvington Varnish & Ins. Co.
Ryle & Co., Wm.
Slate
Portland-Monson Slate Co.
Tape & Webbing
General Electric Co.
Mica Insulator Co.
Packard Electric Co.
Westinghouse Elec. & Mfg. Co.
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Candy Company, Inc.

Insulation, Electric
Bakelite Corporation
Condensite Co. of America
General Bakelite Co.
Redmanol Chem. Prod. Co.

Insulator Pins
Hubbard & Co.

Insulator Tester & Fault Finder
Johnson, Jr., T. F.

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Hemingray Glass Co.
Lapp Insulator Co., Inc.
Locke Insulator Corp.
Porcelain, Composition
Imperial Porcelain Works
Jeffery-Dewitt Ins. Co.
Lapp Insulator Co., Inc.
Locke Insulator Corp.
Louthan Mfg. Co.
Mica Insulator Co.
Ohio Brass Co.
Westinghouse Elec. & Mfg. Co.
Post Type
Delta Star Electric Co.
Electrical Development & Mach. Co.

Insulator Tester & Fault Finder
Johnson, Jr., T. F.

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Jacks, Pole Pulling and Straightening
Westinghouse Elec. & Mfg. Co.

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Electrical Testing Laboratories

Lamination Materials
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Condensite Co. of America
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Redmanol Chem. Prod. Co.

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Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Incandescent
Consolidated Elec. Lamp. Co.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
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General Electric Co.
Westinghouse Elec. & Mfg. Co.

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Elec. Service Supplies Co.
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G & W Elec. Spec. Co.
General Electric Co.
Hubbard & Co.
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Gifford-Wood Co.

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Lunkenheimer Co.

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Cutler-Hammer Mfg. Co.
Dudlo Mfg. Co.
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Cutler-Hammer Mfg. Co.

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American Engr. Co.

Meter Testers
General Electric Co.
Westinghouse Elec. & Mfg. Co.

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Mica Insulator Co.

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Allis-Chalmers Mfg. Co.

Molded Insulation (See Insulation, Molded)
Wesche Electric Co., B. A.

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Redmanol Chem. Prod. Co.

Molding Materials
Bakelite Corporation
Condensite Co. of America
General Bakelite Co.
Redmanol Chem. Prod. Co.

Molding, Metal
National Metal Molding Co.

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Allis Co., Louis
Baldor Electric Co.
Bodine Elec. Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Electric Machy Mfg. Co.
Electric Specialty Co.
Electro-Dynamic Co.
Fairbanks, Morse & Co.
General Electric Co.
Gregory Electric Co.
Imperial Elec. Co.
Kimble Electric Co.
Peerless Electric Co.
Reliance Elec. & Eng. Co. Co.
Robbins & Myers Co.
Star Elec. Motor Co.
Sturtevant Co., B. F.
Wesche Electric Co., B. A.
Western Electric Co.
Westinghouse Elec. & Mfg.

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Spray Engineering Co.

Oil Burners
Todd Shipyards Corp.

Oil Engines (See Engines)

Oil Pressure Governors
Lombard Governor Co.

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General Electric Co.
Westinghouse Elec. & Mfg. Co.

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General Electric Co.
Westinghouse Elec. & Mfg. Co.

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General Elec. Co.
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Pelton Water Wheel Co.

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Leeds & Northrup Co.

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Superheater Co.

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Crane Co.

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Riter-Conley Co.
Wood
Continental Pipe Mfg. Co.

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Baker & Co., Inc.

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Cutler-Hammer Mfg. Co.
National Metal Molding Co.

Plugs, Attachment
Cutler-Hammer Mfg. Co.
General Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Hubbard & Co.
Western Electric Co.

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Hubbard & Co.

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Archbold-Brady Co.
Steel
Aermotor Co.
Bates Exp. Steel Truss Co.
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.
Riter-Conley Co.
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Naugle Pole & Tie Co.
Partridge Lumber Co., T. M.
Valentine-Clark Co.
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Porcelain (See Insulating Material, China and Porcelain)

Posts
Wood
Naugle Pole & Tie Co.

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Leeds & Northrup Co.
Westinghouse Elec. & Mfg. Co.

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G & W Elec. Spec. Co.

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Bliss Co., E. W.

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Electric Service Supplies Co.

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Centrifugal
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I. R. Nelson Co.
Olson Boettger Elec. Mfg. Co.

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Railway & Industrial Eng. Co.
Westinghouse Elec. & Mfg. Co.

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General Electric Co.
Sundh Electric Co.
Valley Electric Co.
Westinghouse Elec. & Mfg. Co.
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Hartford Mach. Screw Co.

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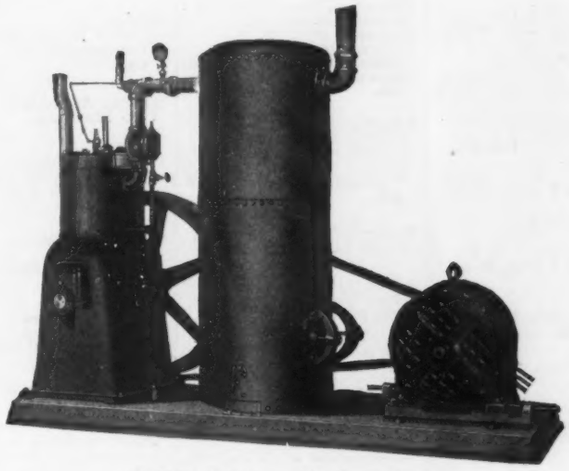

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Coleman-Shoemaker
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Hall & Co., Stephen
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Hemphill & Co., J. L., Inc.
Independent Elec. Mach. Co.
Kansas City Power & Light Co.
Klein & Co., Nathan
Land, L. J.
MacGovern & Co.
Markman Engr. Co.
Miller-Owen Electric Co.
Nashville Industrial Corp.
National Business Bourse
Nussbaum Co., V. M.
Power Machy. Exchange
Reliable Electric Co.
Ross Power Equip. Co.
Surety Motor Bonding Co.
Thompson & Jameson, Inc.
Tiffany Electric Co.
Toomey, Frank, Inc.
Wickes Mchy. Co.
Willey Wray Elec. Co.

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Oil
Elliott Co.
Steam
Elliott Co.

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Ostrander & Co., W. R.

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Rome Brass & Copper Co.
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Wheeling Steel Products Co.
Metal
American Sheet & Tin Plate Co.
Bliss Co., E. W.

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General Electric Co.
National Metal Molding Co.
Ostrander & Co., W. R.
Westinghouse Elec. & Mfg. Co.

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Waterbury Mfg. Co.

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Blake Signal & Mfg. Co.

Soldering Irons
Cutler-Hammer Mfg. Co.

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Spray Nozzles
Buffalo Forge Co.

Springs
American Steel & Wire Co.

Sprockets, Silent Chain
Morse Chain Co.

Staples
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters, Motor, Electric
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Power Specialty Co.

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American Engr. Co.
Babcock & Wilcox Co.
Combustion Engineering Corp.
General Electric Co.
Riley Stoker Co., Sanford
Westinghouse Elec. & Mfg. Co.

Chain Grate
Green Eng. Co.

Stokers, Pulverized Coal
Combustion Engineering Corp.

Stoves (See Ranges)

Strainers
Oil
Elliott Co.
Water
Elliott Co.

Structural Steel
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.

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Elec'l Engineers Equip. Co.
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Railway & Industrial Eng. Co.
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Superheater Co.

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Electric Power Equip. Corp.
Elec'l Engineers Equip. Co.
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Tools, Linemen's (See Linemen's Supplies & Tools)

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Leffel & Sons Co., James
Pelton Water Wheel Co.

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Lombard Governor Co.
Pelton Water Wheel Co.
Woodward Governor Co.

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Copper Clad Steel Co.
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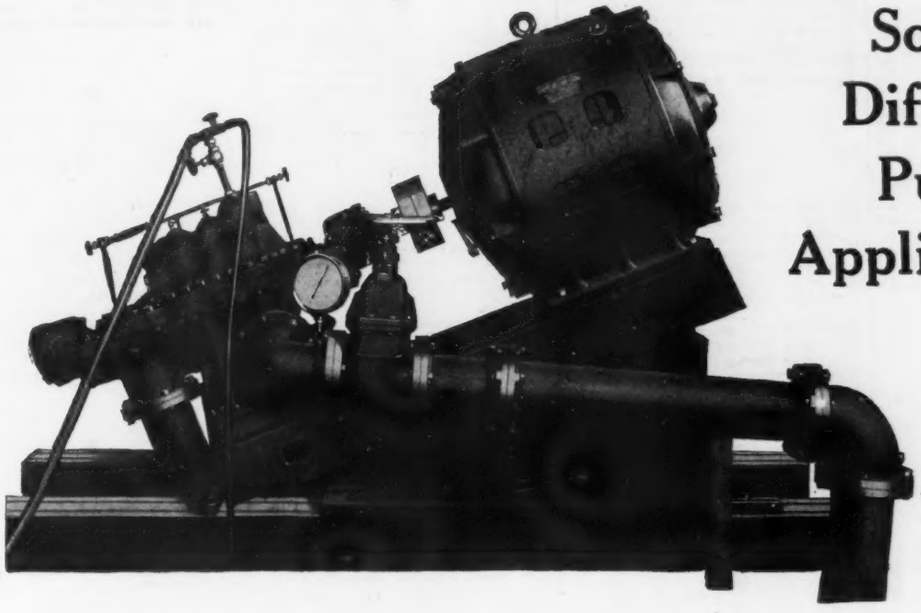

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The pumping unit illustrated consists of an Allis-Chalmers multistage centrifugal pump and Allis-Chalmers induction motor designed to operate at an inclined position, as it was intended for gradually lowering down a mine slope on a special truck to drain the mine. Special oil-tight combined radial and ball thrust bearings and other special features were used to make it suitable for the intended service and a shop test was run at the inclined position before shipment.

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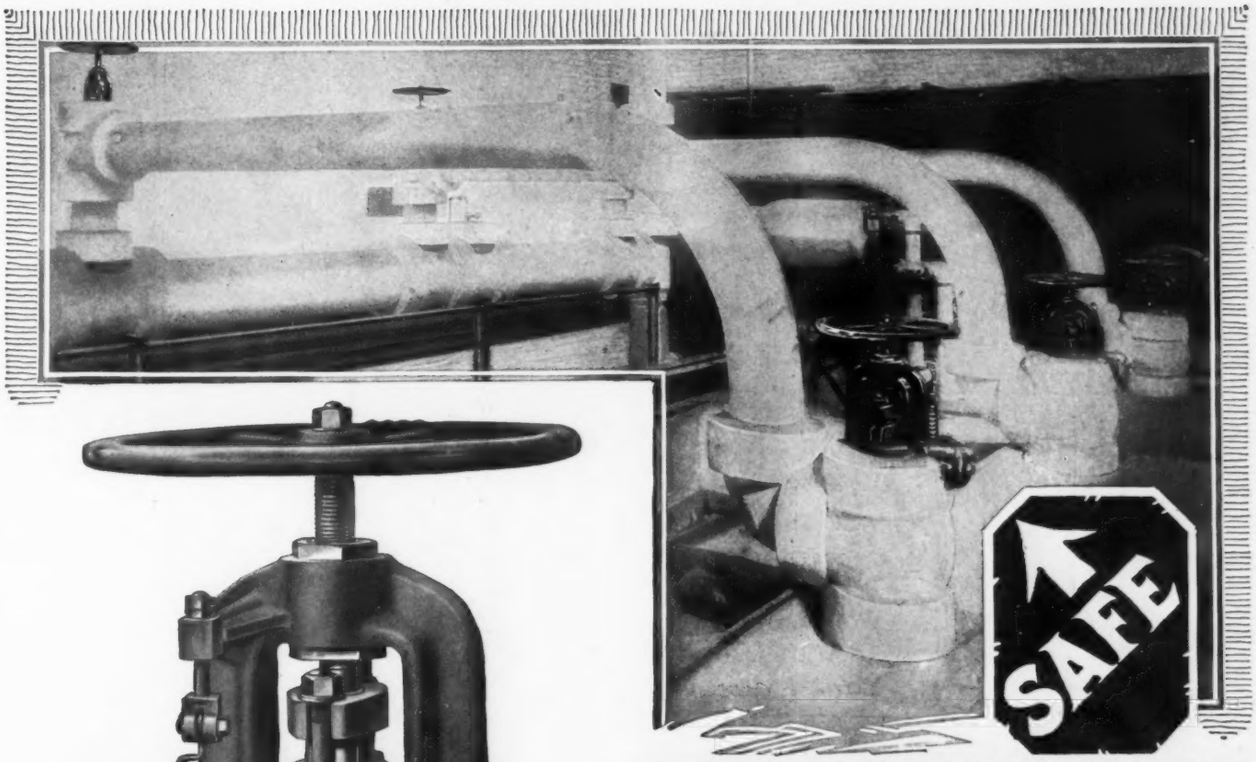

Fig. 700

"Essential for the safe operation of boilers connected in battery"

10-19-13

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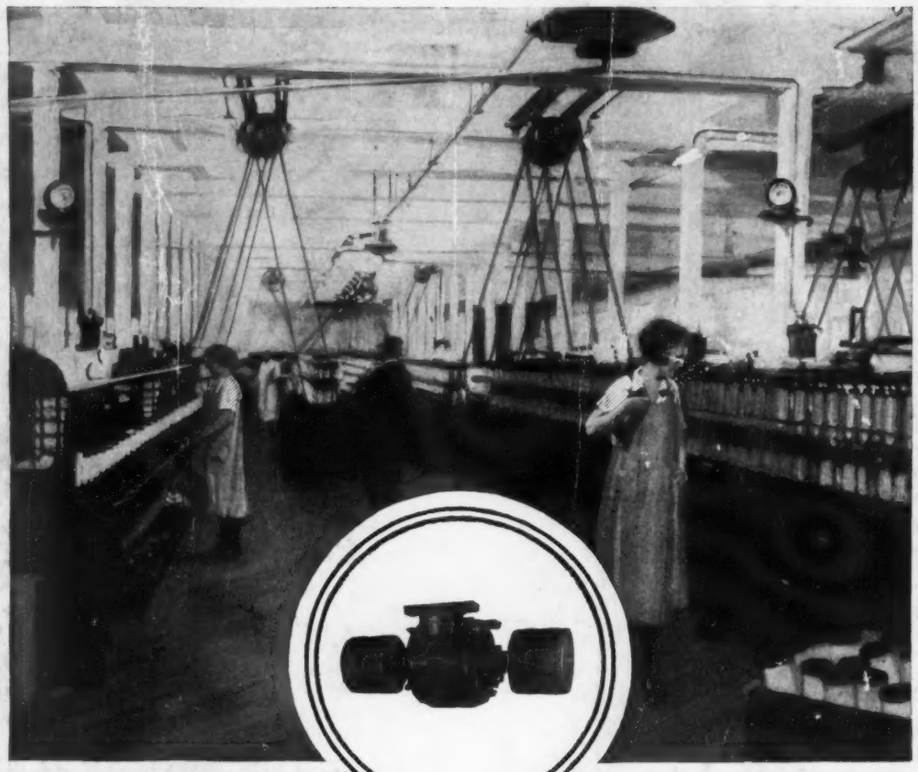

Drawn from a photograph in Mills of Bloomfield Mfg. Co., Statesville, N. C., showing R & M Four Frame Drive Motors, also Bahnson Humidifiers, which are R & M motor equipped.

IN the humid, lint laden atmosphere of the textile mill R & M Motors operate with that unfailing reliability they show in all other industrial plants. Their thoroughly moisture-proofed windings, over-size, dust-proof bearings heavy frames and low temperature ratings provide a margin of safety which insures long life, and dependability in every class of industry, whether service conditions are normal or severe.

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